



VERIFICATION OF TRANSLATION

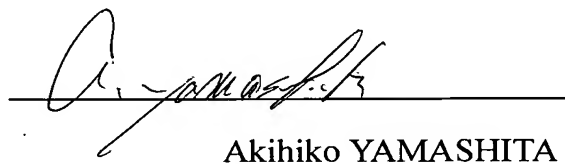
I, Akihiko YAMASHITA of 3rd Floor, Oak Building Kyobashi, 16-10,
Kyobashi 1-chome, Chuou-ku, Tokyo, 104-0031 Japan, declare as follows:

1. That I am well acquainted with both English and Japanese languages,
and

2. That the attached document is a true and correct translation made by
me to the best of my knowledge and belief of:

The specification accompanying the Application No. 2002-249608 for a
Patent made in Japan filed on August 28, 2002.

October 9, 2008


Akihiko YAMASHITA

(No witness required)



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[Document Title] SPECIFICATION

[Title of the Invention] METHOD FOR MANUFACTURING CONDUCTIVE
PATTERN FORMING BODY

[Patent Claims]

[Claim 1] A method for manufacturing a conductive pattern
forming body comprising:

a photocatalyst containing layer side substrate preparing
process of preparing a photocatalyst containing layer side
substrate comprising a photocatalyst containing layer which
contains a photocatalyst and a base material;

a pattern forming body preparing process of preparing a
pattern forming body substrate comprising a property variable
layer whose property is changed by an action of a photocatalyst
in the photocatalyst containing layer;

a property variable pattern forming process of placing
a photocatalyst containing layer and the property variable layer
in contact, and then, irradiating with energy from predetermined
direction to form a property variable pattern, whose property
is changed, on a surface of the property variable layer;

a metal colloid coating process of adhering a metal
colloid in a pattern to the surface of the pattern forming body
substrate on which the property variable pattern is formed by
coating the metal colloid; and

a conductive pattern forming process of forming
conductive pattern by solidifying the metal colloid adhered in
a pattern to the property variable pattern.

[Claim 2] A method for manufacturing a conductive pattern
forming body comprising:

a property variable pattern forming process of placing

a photocatalyst containing layer side substrate comprising a base member and a photocatalyst containing layer containing a photocatalyst, and a pattern forming body substrate comprising a property variable layer whose property is changed by an action of a photocatalyst in the photocatalyst containing layer so that the photocatalyst containing layer and the property variable layer are placed with a gap of 200 μm or less, and then, irradiating with energy from predetermined direction to form a property variable pattern, whose property is changed, on a surface of the property variable layer;

a metal colloid coating process of adhering a metal colloid in a pattern to the surface of the pattern forming body substrate on which the property variable pattern is formed by coating the metal colloid; and

a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered in a pattern to the property variable pattern.

[Claim 3] The method for manufacturing a conductive pattern forming body according to claim 1 or 2 wherein, after the conductive pattern forming process, the method further comprises a non-drawn part removing process of removing a non-conductive pattern part which is a part where the wettability variable layer is exposed on the pattern forming substrate surface.

[Claim 4] The method for manufacturing a conductive pattern forming body according to claim 3 wherein the non-drawn part removing process is a process of removing the wettability variable layer by an alkali solution.

[Claim 5] The method for manufacturing a conductive pattern

forming body according to any one of claims 1 to 4 wherein the photocatalyst containing layer side substrate comprises the base material and the photocatalyst containing layer formed on the base material in a pattern.

[Claim 6] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 4 wherein the photocatalyst containing layer side substrate prepared in the photocatalyst containing layer side substrate preparing process comprises the base material, the photocatalyst containing layer formed on the base material, and a photocatalyst containing layer side light shielding part formed in a pattern; and

an energy irradiation in the property variable pattern forming process is carried out from the photocatalyst containing layer side substrate.

[Claim 7] The method for manufacturing a conductive pattern forming body according to claim 6 wherein, in the photocatalyst containing layer side substrate, the photocatalyst containing layer side light shielding part is formed in a pattern on the base material, and the photocatalyst containing layer is further formed thereon.

[Claim 8] The method for manufacturing a conductive pattern forming body according to claim 6 wherein, in the photocatalyst containing layer side substrate, the photocatalyst containing layer is formed on the base material, and the photocatalyst containing layer side light shielding part is formed in a pattern on the photocatalyst containing layer.

[Claim 9] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 8 wherein the photocatalyst containing layer is a layer comprising a

photocatalyst.

[Claim 10] The method for manufacturing a conductive pattern forming body according to claim 9 wherein the photocatalyst containing layer is a layer formed by forming a photocatalyst as a film on the base material by a vacuum film forming method.

[Claim 11] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 8 wherein the photocatalyst containing layer is a layer comprising a photocatalyst and a binder.

[Claim 12] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 11 wherein the photocatalyst is a substance of one or plural kinds selected from the group consists of titanium oxide (TiO_2), zinc oxide (ZnO), tin oxide (SnO_2), strontium titanate (SrTiO_3), tungsten oxide (WO_3), bismuth oxide (Bi_2O_3) and iron oxide (Fe_2O_3).

[Claim 13] The method for manufacturing a conductive pattern forming body according to claim 12 wherein the photocatalyst is titanium oxide (TiO_2).

[Claim 14] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 13 wherein, in the pattern forming body substrate preparing process, the pattern forming body substrate is prepared by forming the property variable layer on a base body.

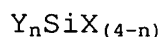
[Claim 15] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 14 wherein the property variable layer is a wettability variable layer whose wettability is changed so as a contact angle to a liquid is reduced by an action of the photocatalyst in the photocatalyst containing layer when energy is irradiated.

[Claim 16] The method for manufacturing a conductive pattern forming body according to claim 15 wherein the wettability variable layer has a contact angle to the metal colloid of 50° or more in a non-energy irradiated part and a contact angle to the metal colloid of 40° or less in a part where energy is irradiated.

[Claim 17] The method for manufacturing a conductive pattern forming body according to claim 15 or 16 wherein the wettability variable layer is a layer containing an organopolysiloxane.

[Claim 18] The method for manufacturing a conductive pattern forming body according to claim 17 wherein the organopolysiloxane is a polysiloxane containing a fluoroalkyl group.

[Claim 19] The method for manufacturing a conductive pattern forming body according to claim 17 or 18 wherein the organopolysiloxanes is a hydrolysis condensate or co-hydrolysis condensate of one kind or two or more kinds of silicon compounds represented by the following formula:



, in which Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group or a halogen and "n" denotes an integer from 0 to 3.

[Claim 20] The method for manufacturing a conductive pattern forming body according to any one of claims 15 to 19 wherein the pattern forming body substrate comprises the wettability variable layer having a self-supporting ability.

[Claim 21] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 14 wherein the

property variable layer is a decomposition removal layer which is decomposed and removed by an action of the photocatalyst in the photocatalyst containing layer when energy is irradiated.

[Claim 22] The method for manufacturing a conductive pattern forming body according to claim 21 wherein a contact angle of a liquid to the decomposition removal layer is different from a contact angle of a liquid to the base body bared by the decomposition and removal of the decomposition removal layer.

[Claim 23] The method for manufacturing a conductive pattern forming body according to claim 21 or 22 wherein the decomposition removal layer is any one of a self-assembled monolayer, a Langmuir Blodgett film, and a layer-by-layer self-assembled film.

[Claim 24] The method for manufacturing a conductive pattern forming body according to any one of claims 21 to 23 wherein the decomposition removal layer has a contact angle to the metal colloid of 50° or more and the base body has a contact angle to the metal colloid of 40° or less.

[Claim 25] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 24 wherein a clearance between the photocatalyst containing layer and the surface of the property variable layer is in a range of 0.2 μm to 10 μm , when energy is irradiated to the surface of the property variable layer.

[Claim 26] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 25 wherein the irradiation of energy is conducted while heating the photocatalyst containing layer.

[Claim 27] The method for manufacturing a conductive pattern

forming body according to any one of claims 1 to 26 wherein the property variable layer is a layer containing no photocatalyst.

[Claim 28] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 27 wherein the metal colloid is a silver colloid or a gold colloid using water as a medium.

[Claim 29] The method for manufacturing a conductive pattern forming body according to any one of claims 1 to 28 wherein the coating of the metal colloid in the metal colloid coating process is a dip coating method or a spin coating method.

[Claim 30] The method for manufacturing a conductive pattern forming body according to any one claims 1 to 28 wherein the coating of the metal colloid in the metal colloid coating process is a nozzle discharging method.

[Claim 31] The method for manufacturing a conductive pattern forming body according to claim 30 wherein the nozzle discharging method is an ink jet method.

[Claim 32] A conductive pattern forming body comprising: a wettability variable layer whose wettability is changed by an action of a photocatalyst; and a metal composition formed on the wettability variable layer by solidifying a metal colloid in a pattern.

[Claim 33] The conductive pattern forming body according to claim 32 wherein the wettability variable layer is formed on a base body.

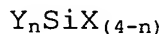
[Claim 34] The method for manufacturing a conductive pattern forming body according to claim 32 or 33 wherein the wettability variable layer has a contact angle to the metal colloid of 50° or more in a non-energy irradiated part and a contact angle to

the metal colloid of 40° or less in a part where energy is irradiated.

[Claim 35] The method for manufacturing a conductive pattern forming body according to any one of claims 32 to 34 wherein the wettability variable layer is a layer containing an organopolysiloxane.

[Claim 36] The conductive pattern forming body according to claim 35 wherein the organopolysiloxane is a polysiloxane containing a fluoroalkyl group.

[Claim 37] The method for manufacturing a conductive pattern forming body according to claim 35 or 36 wherein the organopolysiloxanes is a hydrolysis condensate or co-hydrolysis condensate of one kind or two or more kinds of silicon compounds represented by the following formula:



, in which Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group or a halogen and "n" denotes an integer from 0 to 3.

[Claim 38]. A conductive pattern forming body comprising: a base body; a decomposition removal layer on the base body which is decomposed and removed by an action of a photocatalyst; and a metal composition formed on the base body which is bared by the decomposition and removal of the decomposition removal layer, by solidifying a metal colloid in a pattern.

[Claim 39] The conductive pattern forming body according to claim 38 wherein a contact angle of the decomposition removal layer to a liquid is different from a contact angle of the base body, which is bared by the decomposition of the decomposition

removal layer, to a liquid.

[Claim 40] The conductive pattern forming body according to claim 38 or 39 wherein the decomposition removal layer is any one of a self-assembled monolayer, a Langmuir Blodgett film and a layer-by-layer self-assembled film.

[Claim 41]- The method for manufacturing a conductive pattern forming body according to any one of claims 38 to 40 wherein the decomposition removal layer has a contact angle to the metal colloid of 50° or more and the base body has a contact angle to the metal colloid of 40° or less.

[Claim 42] A conductive pattern forming body comprising: a base body; a wettability variable layer formed in a pattern on the base body whose wettability is changed by an action of a photocatalyst; and a metal composition formed on the wettability variable layer, by solidifying a metal colloid.

[Detailed description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a method for manufacturing a conductive pattern forming body which may be used in coatings such as various highly precise electric circuits such as a printed-circuit board.

[0002]

[Prior Art]

Conventionally, when highly precise conductive pattern forming body such as a printed-circuit board is manufactured, a photoresist such as a dry film is laminated on a copper-clad laminate which is formed by plating the entire surface of a substrate with copper, followed by pattern-exposure using a photomask or the like and developing, thereby forming the conductive pattern forming body.

[0003]

However, in such a method using photolithography method, it is necessary to pass through various processes such as plating of a substrate with a metal, formation of a photoresist layer, exposure and developing, making the method for manufacturing complicated and a cost may be a problem. Also, a large amount of waste liquid occurring from developing is harmful, and there is an environmental problem that treatments are necessary to drain these waste liquids outside.

[0004]

Also, there is a method for manufacturing a printed-circuit board by a method using screen printing. However, this method has a problem on precision so that it cannot

be applied to the case of manufacturing a highly precise conductive pattern.

[0005]

[Problem to be Solved by the Invention]

The present invention has been conducted in view of the above problems and it is a main object to provide a method for manufacturing a conductive pattern, which is capable of forming a highly precise pattern by a simple process and being free from such a problem concerning treatment of waste fluids.

[0006]

[Means for Solving the Problem]

As recited in claim 1, provided is a method for manufacturing a conductive pattern forming body comprising:

a photocatalyst containing layer side substrate preparing process of preparing a photocatalyst containing layer side substrate comprising a photocatalyst containing layer which contains a photocatalyst and a base material;

a pattern forming body preparing process of preparing a pattern forming body substrate comprising a property variable layer whose property is changed by an action of a photocatalyst in the photocatalyst containing layer;

a property variable pattern forming process of placing a photocatalyst containing layer and the property variable layer in contact, and then, irradiating with energy from predetermined direction to form a property variable pattern, whose property is changed, on a surface of the property variable layer;

a metal colloid coating process of adhering a metal colloid in a pattern to the surface of the pattern forming body substrate on which the property variable pattern is formed by

coating the metal colloid; and

a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered in a pattern to the property variable pattern.

[0007]

According to the present invention, the metal colloid can be formed in a pattern on the wettability variable layer whose property is changed by carrying out treatment of adhering the metal colloid thereto by using, for example, a dip coating method or an ink jet method, and can be made into a highly precise conductive pattern by solidifying it. As a consequence, since a highly precise conductive pattern can be formed in a simple process with high accuracy, a highly precise conductive pattern can be formed at a low cost. Further, when the property variable layer is made of, for example, an insulated material, a highly precise conductive pattern can be formed.

[0008]

As recited in claim 2, provided is a method for manufacturing a conductive pattern forming body comprising:

a property variable pattern forming process of placing a photocatalyst containing layer side substrate comprising a base member and a photocatalyst containing layer containing a photocatalyst, and a pattern forming body substrate comprising a property variable layer whose property is changed by an action of a photocatalyst in the photocatalyst containing layer so that the photocatalyst containing layer and the property variable layer are placed with a gap of 200 μm or less, and then, irradiating with energy from predetermined direction to form a property variable pattern, whose property is changed, on a

surface of the property variable layer;

a metal colloid coating process of adhering a metal colloid in a pattern to the surface of the pattern forming body substrate on which the property variable pattern is formed by coating the metal colloid; and

a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered in a pattern to the property variable pattern.

[0009]

According to the present invention, by placing the photocatalyst containing layer and the property variable layer with a predetermined clearance and irradiating with energy, the properties of the energy irradiated part of the property variable layer can be varied efficiently, thereby a pattern can be formed. It is therefore possible to produce a conductive pattern forming body having a highly precise property varied pattern without any particular after treatment after energy irradiation. Further, when the property variable layer is made of, for example, an insulated material, a highly precise conductive pattern can be formed.

[0010]

In the invention recited in claim 1 or 2, as recited in claim 3, after the conductive pattern forming process, the method may further comprise a non-drawn part removing process of removing a non-conductive pattern part which is a part where the wettability variable layer is exposed on the pattern forming substrate surface. Thereby, when the property variable layer is formed by a conductive material, the property variable layer can be removed to expose the insulating base body so that a

conductive pattern forming body is obtained.

[0011]

In the invention recited in claim 3, as recited in claim 4, the non-drawn part removing process is a process of removing the property variable layer by an alkali solution. Thereby, it is possible to easily remove the property variable layer and preferable in terms of production efficiency and production costs.

[0012]

In the invention recited in any one of claims 1 to 4, as recited in claim 5, it is preferable that the photocatalyst containing layer side substrate comprises the base material and the photocatalyst containing layer formed on the base material in a pattern. This is because patterns differing in properties can be formed on the property variable layer without using a photomask by forming the base material in a pattern in the above manner. Also, since the properties of only the surface which is in contact with or facing to the photocatalyst containing layer is varied, the irradiated energy is not limited to the parallel energy, and also, the energy irradiating direction is not particularly limited. Therefore, there are merits that the freedom of type and arrangement of an energy source are greatly increased.

[0013]

In the invention recited in any one of claims 1 to 4, as recited in claim 6, it is preferable that the photocatalyst containing layer side substrate prepared in the photocatalyst containing layer side substrate preparing process comprises the base material, the photocatalyst containing layer formed on the

base material, and a photocatalyst containing layer side light shielding part formed in a pattern; and the energy irradiation in the property variable pattern forming process is carried out from the photocatalyst containing layer side substrate.

[0014]

This reason is that since the photocatalyst containing layer side substrate is provided with the photocatalyst containing layer side light shielding part, it is not necessary to use a photomask when energy is irradiated, and therefore, alignment with a photomask is not needed, which makes it possible to simplify the process.

[0015]

In the invention recited in claim 6, as recited in claim 7, in the photocatalyst containing layer side substrate, the photocatalyst containing layer side light shielding part may be formed in a pattern on the base material, and the photocatalyst containing layer may further be formed thereon. Moreover, as recited in claim 8, in the photocatalyst containing layer side substrate, the photocatalyst containing layer is formed on the base material, and the photocatalyst containing layer side light shielding part may be formed in a pattern on the photocatalyst containing layer.

[0016]

It may be said that the photocatalyst containing layer side light shielding part is preferably placed in contact with or close to the property variable layer, in terms of the precision of a resulting property variable pattern. It is therefore preferable to place the photocatalyst containing layer side light shielding part at the aforementioned position.

Also, in a case of forming the photocatalyst containing layer side light shielding part on the photocatalyst containing layer, there is an advantage that it may be used as a spacer when the photocatalyst containing layer and the property variable layer are contacted or faced in the above property variable pattern forming process.

[0017]

In the invention recited in any one of claims 1 to 8, as recited in claim 9, the photocatalyst containing layer is preferably a layer comprising a photocatalyst. This is because it is possible to improve the efficiency to vary the properties of the property variable layer and to produce effectively a pattern forming body, if the photocatalyst containing layer is made of only a photocatalyst.

[0018]

In the invention recited in claim 9, as recited in claim 10, it is preferable that the photocatalyst containing layer is a layer formed by forming a photocatalyst as a film on the base material by a vacuum film forming method. By accordingly forming the photocatalyst containing layer by a vacuum film forming method, the photocatalyst containing layer with few irregularities on the surface, with even film thickness, and uniform quality can be formed so that the property variable pattern on the surface of the property variable layer can be formed evenly and high efficiently.

[0019]

In the invention recited in any one of claims 1 to 8, as recited in claim 11, the photocatalyst containing layer may be a layer comprising a photocatalyst and a binder. By accordingly

using a binder, the photocatalyst containing layer can be formed relatively easily, with the result that the pattern forming body can be manufactured at a low cost.

[0020]

In the invention recited in any one of claims 1 to 11, as recited in claim 12, the photocatalyst is preferably a substance of one or plural types selected from the group consists of titanium oxide (TiO_2), zinc oxide (ZnO), tin oxide (SnO_2), strontium titanate (SrTiO_3), tungsten oxide (WO_3), bismuth oxide (Bi_2O_3) and iron oxide (Fe_2O_3). In particular, as recited in claim 13, it is preferable that the photocatalyst is titanium oxide (TiO_2). This is because titanium dioxide has high band gap energy, it is effective as a photocatalyst, and also, it is chemically stable without any toxicity, and is easily available.

[0021]

In the invention recited in any one of claims 1 to 13, as recited in claim 14,, it is preferable that, in the pattern forming body substrate preparing process, the pattern forming body substrate is prepared by forming the property variable layer on a base body. This is because, when the property variable layer has low strength and has no self-supporting ability, the property variable layer is preferably formed on the base body.

[0022]

In the invention recited in any one of claims 1 to 14, as recited in claim 15, it is preferable that the property variable layer is a wettability variable layer whose wettability is changed so as a contact angle to a liquid is reduced by an

action of the photocatalyst in the photocatalyst containing layer when energy is irradiated. When the property variable layer is a wettability variable layer, an energy irradiated area can be made to be a lyophilic area, and a non-energy irradiated area can be made to be a liquid repellent area. Therefore, it is possible to adhere the metal colloid only to the lyophilic area by utilizing the difference in wettability and the conductive pattern can be formed with ease.

[0023]

In the invention recited in claim 15, as recited in claim 16, the wettability variable layer has a contact angle to the metal colloid of 50° or more in a non-energy irradiated part and a contact angle to the metal colloid of 40° or less in a part where energy is irradiated. When the wettability of the liquid repellent area of the wettability variable layer which is the non-energy irradiated part and the wettability of the energy-irradiated part of the wettability variable layer which is the lyophilic area are not within the above-mentioned ranges, it may not be possible to have the metal colloid adhere only to the lyophilic area when the metal colloid is coated entirely.

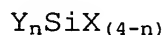
[0024]

In the invention recited in claim 15 or 16, as recited in claim 17, it is preferable that the wettability variable layer is a layer containing an organopolysiloxane. In the present invention, the properties required for the wettability variable layer are that it has liquid repellency by an action of the photocatalyst in the contacting or facing photocatalyst treatment layer, when it is not irradiated with energy, and it becomes lyophilic when it is irradiated with energy. Therefore,

it is preferable to use the organopolysiloxane as a material imparting such properties to the wettability variable layer.
[0025]

In the invention recited in claim 17, as recited in claim 18, the organopolysiloxane is preferably an organopolysiloxane containing a fluoroalkyl group. By containing a fluoroalkyl group, a difference in wettability between an energy irradiated part and a non-irradiated part can be increased.
[0026]

In the invention recited in claim 17 or 18, as recited in claim 19, the organopolysiloxanes is a hydrolysis condensate or co-hydrolysis condensate of one kind or two or more kinds of silicon compounds represented by the following formula:



, in which Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group or a halogen and "n" denotes an integer from 0 to 3. Using of such organopolysiloxanes allows the invention to exhibit the above-mentioned properties to the changes in the wettability.

[0027]

In the invention recited in any one of claims 15 to 19, as recited in claim 20, the pattern forming body substrate may comprise the wettability variable layer having a self-supporting ability. This is because when the wettability variable layer has self-supporting ability, it is not necessary to use a base body or the like and the pattern forming body can be manufactured at a low cost if, for example, a commercially available resin plate is used.

[0028]

In the invention recited in any one of claims 1 to 14, as recited in claim 21, it is preferable that the property variable layer is a decomposition removal layer which is decomposed and removed by an action of the photocatalyst in the photocatalyst treatment layer when energy is irradiated. The reason is that when the property variable layer is a decomposition removal layer, irregularities can be formed on the surface by the above energy irradiation, and therefore, the metal colloid can be adhered easily by, for example, an ink jet method.

[0029]

In the invention recited in claim 21, as recited in claim 22, it is preferable that a contact angle of a liquid to the decomposition removal layer is different from a contact angle of a liquid to the base material bared by the decomposition and removal of the decomposition removal layer. By this, the bared base material, that is irradiated with energy, can be a lyophilic area, and a part with the decomposition removal layer remaining, that is not irradiated with energy, can be a liquid repellent area. Therefore, the metal colloid can be adhered easily.

[0030]

In the invention recited in claim 21 or 22, as recited in claim 23, it is preferable that the decomposition removal layer is any one of a self-assembled monolayer, a Langmuir Blodgett film, and a layer-by-layer self-assembled film. This is because when the decomposition removal layer is the above film, a relatively high strength film with no defects can be formed easily.

[0031]

In the invention recited in any one of claims 21 to 23, as recited in claim 24, the decomposition removal layer has a contact angle to the metal colloid of 50° or more and the base body has a contact angle to the metal colloid of 40° or less. When wettability of liquid repellent area which is made of the remaining decomposition removal layer not irradiated with energy and the wettability of the lyophilic area which is the area where the based body is exposed by energy irradiation are not within the above-mentioned rage, it may not be possible to have the metal colloid adhere only to the lyophilic area when the metal colloid is coated entirely.

[0032]

In the invention recited in any one of claims 1 to 24, as recited in claim 25, it is preferable that a clearance between the photocatalyst containing layer and the surface of the property variable layer is in a range of 0.2 μm to 10 μm , when energy is irradiated to the surface of the property variable layer. By irradiating energy with a clearance of the above range, when irradiating the above mentioned energy, the properties of the surface of the property variable layer can be changed more efficiently.

[0033]

In the invention recited in any one of claims 1 to 25, as recited in claim 26, the irradiation of energy is preferably conducted while heating the photocatalyst containing layer. By heating the photocatalyst, the sensitivity of photocatalyst is enhanced and it is possible to effectively vary properties of the wettability variable layer.

[0034]

In the invention recited in any one of claims 1 to 26, as recited in claim 27, it is preferable that the property variable layer is a layer containing no photocatalyst. As mentioned above, in the present invention, since the property variable layer is a layer containing no photocatalyst, a problem that the property variable layer is affected with time can be avoided.

[0035]

Further in the invention recited in any one of claims 1 to 27, as recited in claim 28,, it is preferable that the metal colloid is a silver colloid or a gold colloid using water as a medium.

[0036]

In the invention recited in any one of claims 1 to 28, as recited in claim 29, the coating of the metal colloid in the metal colloid coating process may be a dip coating method or a spin coating method.

[0037]

Also, in the invention recited in any one of claims 1 to 27, as recited in claim 30, the coating of the metal colloid in the metal colloid coating process may be a nozzle discharging method. Among the above, an ink jet method is preferable as recited in claim 31.

[0038]

As recited in claim 32, provided is a conductive pattern forming body comprising: a wettability variable layer whose wettability is changed by an action of a photocatalyst; and a metal composition formed on the wettability variable layer by

solidifying a metal colloid in a pattern. According to the present invention, since the wettability variable layer is provided, the metal composition can be formed easily. Moreover, when the wettability variable layer has insulating property, it is possible to form an excellent conductive pattern forming body.

[0039]

In the invention recited in claim 32, as recited in claim 33, the wettability variable layer may be formed on a base body. This is because the property variable layer is preferably formed on the base body when the wettability variable layer has low strength and no self-supporting ability.

[0040]

In the invention recited in claim 32 or 33, as recited in claim 34, the wettability variable layer has a contact angle to the metal colloid of 50° or more in a non-energy irradiated part and a contact angle to the metal colloid of 40° or less in a part where energy is irradiated. Thereby, it is possible to make the energy irradiated part a lyophilic area and the energy non-irradiated part a liquid repellent area and a conductive pattern forming body can be produced with ease and therefore preferable in terms of production efficiency and costs.

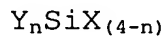
[0041]

In the invention recited in any one of claims 32 to 34, as recited in claim 35, it is preferable that the wettability variable layer is a layer containing an organopolysiloxane. Among the above, the organopolysiloxane is preferably a polysiloxane containing a fluoroalkyl group as recited in claim

36. This reason is that such wettability variable layer can obtain a large change in wettability by energy irradiation.

[0042]

In the invention recited in claim 35 or 36, as recited in claim 37, the organopolysiloxanes is a hydrolysis condensate or co-hydrolysis condensate of one kind or two or more kinds of silicon compounds represented by the following formula:



, in which Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group or a halogen and "n" denotes an integer from 0 to 3. This is because, using of such organopolysiloxanes as materials to form a wettability variable layer allows the invention to obtain a conductive pattern forming body with a big wettability difference.

[0043]

As recited in claim 38, provided is a conductive pattern forming body comprising: a base body; a decomposition removal layer on the base body which is decomposed and removed by an action of a photocatalyst; and a metal composition formed on the base body which is bared by the decomposition and removal of the decomposition removal layer, by solidifying a metal colloid in a pattern.

[0044]

According to the present invention, since the decomposition removal layer is provided, a pattern having irregularities can be formed on the base material. And by utilizing the irregularities, a conductive pattern can be formed easily. Also, when the decomposition removal layer has

insulating property, it is possible to form an excellent conductive pattern forming body.

[0045]

In the invention recited in claim 38, as recited in claim 39, it is preferable that a contact angle of the decomposition removal layer to a liquid is different from a contact angle of the base body, which is bared by the decomposition of the decomposition removal layer, to a liquid. By this, besides the surface irregularities, a part with bared base body, that is irradiated with energy, can be a lyophilic area and a part with the decomposition removal layer remaining, that is not irradiated with energy, can be a liquid repellent area. Therefore, the conductive pattern can be formed easily.

[0046]

In the invention recited in claim 38 or 39, as recited in claim 40, it is preferable that it is any one of a self-assembled monolayer, a Langmuir Blodgett film and a layer-by-layer self-assembled film. This is because when the decomposition removal layer is the above film, it is possible to easily form a relatively high strength film with no defects.

[0047]

In the invention recited in any one of claims 38 to 40, as recited in claim 41, the decomposition removal layer has a contact angle to the metal colloid of 50° or more and the base body has a contact angle to the metal colloid of 40° or less. Thereby, it is possible to make the energy irradiated part where the based body exposed part a lyophilic area and the energy non-irradiated part where the decomposition removal part is remaining a liquid repellent area and a conductive pattern

forming body can be produced with ease and therefore preferable in terms of production efficiency and costs.

[0048]

As recited in claim 42, provided is a conductive pattern forming body comprising: a base body; a wettability variable layer formed in a pattern on the base body whose wettability is changed by an action of a photocatalyst; and a metal composition formed on the wettability variable layer, by solidifying a metal colloid. By providing the wettability variable layer on the base body, a conductive pattern forming body can be easily produced. Further, when the base body has insulating property, it is possible to form an excellent conductive pattern forming body.

[0049]

[Preferred embodiment of the Invention]

The present invention relates to a method for manufacturing a conductive pattern forming body and to a conductive pattern forming body. Each will be explained hereinbelow.

[0050]

A. Method for manufacturing a conductive pattern forming body

First, the method for manufacturing a conductive pattern forming body according to the present invention will be explained.

[0051]

The method for manufacturing a conductive pattern forming body of the present invention comprises: a photocatalyst containing layer side substrate preparing process of preparing a photocatalyst containing layer side substrate comprising a

photocatalyst containing layer which contains a photocatalyst and a base material; a pattern forming body preparing process of preparing a pattern forming body substrate comprising a property variable layer whose property is changed by an action of a photocatalyst in the photocatalyst containing layer; a property variable pattern forming process of placing a photocatalyst containing layer and the property variable layer in contact, and then, irradiating with energy from predetermined direction to form a property variable pattern, whose property is changed, on a surface of the property variable layer; a metal colloid coating process of adhering a metal colloid in a pattern to the surface of the pattern forming body substrate on which the property variable pattern is formed by coating the metal colloid; and a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered in a pattern to the property variable pattern.

[0052]

Another method for manufacturing a conductive pattern forming body of the present invention comprises: a property variable pattern forming process of placing a photocatalyst containing layer side substrate comprising a base member and a photocatalyst containing layer containing a photocatalyst, and a pattern forming body substrate comprising a property variable layer whose property is changed by an action of a photocatalyst in the photocatalyst containing layer so that the photocatalyst containing layer and the property variable layer are placed with a gap of 200 μm or less, and then, irradiating with energy from predetermined direction to form a property variable pattern, whose property is changed, on a surface of

the property variable layer; a metal colloid coating process of adhering a metal colloid in a pattern to the surface of the pattern forming body substrate on which the property variable pattern is formed by coating the metal colloid; and a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered in a pattern to the property variable pattern.

[0053]

The aforementioned photocatalyst containing layer side substrate preparing process and the aforementioned pattern forming body substrate preparing process may be comprised in the method for manufacturing a conductive pattern forming body in this embodiment. However, the above processes are not necessarily comprised if the similar ones, as the photocatalyst containing layer side substrate formed in the below mentioned photocatalyst treatment layer side substrate preparing process and the pattern forming body substrate formed in the pattern forming body substrate preparing process, are used.

[0054]

In the method for manufacturing a conductive pattern forming body in present invention, the photocatalyst containing layer and the property variable layer are placed at predetermined positions, and then, irradiated with energy from a predetermined direction to form a property variable pattern in which the property of the energy irradiated part is changed by an action of the photocatalyst contained in the photocatalyst containing layer. Because after treatments such as development and cleaning after energy irradiation is not necessary in the formation of the pattern, patterns differing in properties can

be formed by fewer processes than before at a low cost. And, a metal colloid is coated to the property variable pattern on the property variable layer, whereby the metal colloid can be adhered in a pattern and a conductive pattern can be formed easily by solidifying this metal colloid.

[0055]

Moreover, in the present invention, the properties of the property variable layer are changed by an action of the photocatalyst contained in the photocatalyst containing layer and then, the photocatalyst containing layer side substrate is dismounted to form the pattern forming body substrate into a conductive pattern forming body. Therefore, the photocatalyst is not necessarily contained in the resulting conductive pattern forming body. Therefore, it is possible to prevent such a disorder that the resulting conductive pattern forming body is affected with time by an action of the photocatalyst.

[0056]

The method for manufacturing a conductive pattern forming body in the present invention as aforementioned will be explained in detail with reference to the drawings. FIG. 1a to 1e are views showing one example of the method for manufacturing a conductive pattern forming body in the present invention.

[0057]

In this example, first, a photocatalyst containing layer side substrate 3 obtained by forming a photocatalyst containing layer 2 on a base body 1 and a pattern forming body substrate 6 obtained by forming a property variable layer 5 on a base body 4 are prepared (see FIG. 1a, a photocatalyst containing layer

side substrate preparing process and a pattern forming body substrate preparing process).

[0058]

Next, as shown in FIG. 1b, the photocatalyst containing layer side substrate 3 and the pattern forming body substrate 6 are irradiated with an ultraviolet light 8 via a photomask 7, on which a necessary property variable pattern is drawn, from the photocatalyst containing layer side substrate 3 side, after the photocatalyst containing layer 2 and the property variable layer 5 are each placed at predetermined positions. As shown in FIG. 1c, by this, a property variable pattern comprising a property variable area 9 and a non-property variable area 10 is formed on the surface of the property variable layer 5 (a property variable pattern forming process).

[0059]

In this case, the photocatalyst containing layer 2 and the property variable layer 5 are placed so as to be in perfectly close contact with each other in FIG. 1. In this embodiment, however, in addition to the case where the both layers are in contact with each other in a physically closely contacted state, the photocatalyst containing layer 2 and the property variable layer 5 may be placed with a clearance which is a gap to an extent that the photocatalyst in the photocatalyst containing layer 2 is actable.

[0060]

Although the above irradiation with ultraviolet rays is carried out via the photomask 7 in the above example, a structure in which the photocatalyst containing layer is formed in a pattern, or a structure in which a light shielding part

(photocatalyst containing layer side light shielding part) is formed in the photocatalyst containing layer side substrate, as mentioned below, may also be used. In this case, energy is irradiated to the entire surface without using the photomask 7 or the like.

[0061]

And a process of dismounting the photocatalyst containing layer side substrate from the pattern forming body substrate 6 is carried out (FIG. 1d), whereby a pattern forming body substrate 6 of which the property variable area 9 and the non-property variable area 10 are formed on the surface can be obtained.

[0062]

Then, a metal colloid is coated to the pattern forming body substrate 6 to adhere the metal colloid only to the property variable area (metal colloid coating process). Then, the metal colloid is cured and a conductive pattern forming body 12 in which a conductive pattern 11 is formed on the property variable layer 5 can be obtained.

[0063]

Such method for manufacturing a conductive pattern forming body in the present invention will be explained by each process in detail.

[0064]

(1) Photocatalyst containing layer side substrate preparing process

The photocatalyst containing layer side substrate preparing process in the present invention is a process of preparing the photocatalyst containing layer containing a

photocatalyst and the photocatalyst containing layer side substrate having a base material.

[0065]

The photocatalyst containing layer side substrate manufactured in this process is provided with at least the photocatalyst containing layer and the base material as aforementioned, and is usually formed of a thin layer of photocatalyst containing layer formed on a base material by predetermined method. Also, as the photocatalyst containing layer side substrate, one provided with a photocatalyst containing layer side light shielding part formed in a pattern or a primer layer may be used.

[0066]

(Photocatalyst containing layer)

The photocatalyst containing layer used in the present invention is not particularly limited as long as it has a structure of which the photocatalyst in the photocatalyst containing layer changes the properties of the property variable layer. The photocatalyst containing layer may be constituted of a photocatalyst and a binder, or may be formed as a film by a photocatalyst alone. Also, the properties of the surface may be lyophilic or liquid repellent.

[0067]

Although the photocatalyst containing layer used in the present invention may be formed on the entire surface of a base material 1 as shown in FIG. 1a and the like, or the photocatalyst containing layer 2 may be formed in a pattern on the base material 1 as shown in FIG. 2.

[0068]

As explained later the property variable pattern forming process, by accordingly forming the photocatalyst containing layer in a pattern, pattern irradiation using a photomask of the photocatalyst containing layer is not necessary when the property variable layer is irradiated with energy. Also, a property variable pattern comprising a property variable area and a non-property variable area can be formed on the property variable layer by irradiating the entire surface.

[0069]

Although there is no particular limitation to a method of patterning the photocatalyst containing layer, the patterning may be carried out by a photolithography method or the like.

[0070]

The photocatalyst containing layer has the advantage that when the photocatalyst containing layer is brought into close contact with or faced to the property variable layer for energy irradiation, the properties of only the part where the photocatalyst containing layer is actually formed is changed, therefore, the energy may be irradiated from any direction as long as the energy is irradiated to the part where the photocatalyst containing layer is brought into close contact with or faced to the property variable layer. And also, the energy to be irradiated is not particularly limited to a parallel one such as parallel light.

[0071]

Although the acting mechanism of the photocatalyst represented by the below mentioned titanium dioxide in the photocatalyst containing layer is not necessarily clear, it is

considered that carriers generated by irradiation with light effect chemical structures of organic materials by a direct reaction with neighboring compounds or by active oxygen species produced in the presence of oxygen or water. In the present invention, it is considered that these carriers effect on the binder component in the photocatalyst containing layer to change the wettability of its surface.

[0072]

Examples of the photocatalyst used in the present invention may be titanium dioxide (TiO_2), zinc oxide (ZnO), tin oxide (SnO_2), strontium titanate (SrTiO_3), tungsten oxide (WO_3), bismuth oxide (Bi_2O_3) and iron oxide (Fe_2O_3). One type or mixtures of two or more types selected from these may be used.

[0073]

In the present invention, titanium dioxide has a high band gap energy, is chemically stable, free from any toxicity, and easily available, and is therefore, particularly preferably used. There are an anatase type and a rutile type of titanium dioxide. Though the both types may be used in the present invention, an anatase type titanium dioxide is preferable. Anatase type titanium dioxide has an excitation wavelength of 380 nm or less.

[0074]

Examples of anatase type titanium dioxide include anatase type titania sol of hydrochloric acid peptisation type (STS-02 (average particle diameter: 7 nm) manufactured by Ishihara Sangyo Kaisha, Ltd., ST-K01 manufactured by Ishihara Sangyo Kaisha, Ltd.), anatase type titania sol of nitric acid peptisation type (TA-15 (average particle diameter: 12 nm)

manufactured by Nissan Chemical Industries, Ltd.), and the like.

[0075]

It is preferable that the particle diameter of the photocatalyst is smaller because a photocatalytic reaction is run effectively. The average particle diameter is preferably 50 nm or less, and it is particularly preferable to use a photocatalyst of 20 nm or less.

[0076]

The photocatalyst containing layer of the present invention may be formed of the photocatalyst alone or as the mixture with a binder as explained above.

[0077]

In the case of the photocatalyst containing layer is formed of the photocatalyst alone, efficiency to the change on the property variable layer improves so that it is advantageous in terms of costs resulting from aspects such as a reduction in treatment time. In the case of the photocatalyst containing layer made of a photocatalyst and a binder, it is advantageous in facilitating the forming of photocatalyst containing layer.

[0078]

In the meantime, examples of a method for forming the photocatalyst containing layer made of a photocatalyst alone may include methods using a vacuum film forming method such as a sputtering method, CVD method, and vacuum deposition method. A photocatalyst containing layer having an even layer and containing only the photocatalyst can be formed by forming it by a vacuum film forming method. This makes it possible to change the property of the property variable layer evenly. Also, since the photocatalyst containing layer is made only of the

photocatalyst, it is possible to change the property of the property variable layer more efficiently than in a case of using the binder.

[0079]

Also, other examples of the method of forming the photocatalyst containing layer made only of the photocatalyst include a method in which, when the photocatalyst is titanium dioxide, amorphous titania is formed on a base material and is then phase-changed to crystal titania by baking. The amorphous titania to be used here can be obtained by hydrolysis and dehydration-condensation of an inorganic salt of titanium such as titanium tetrachloride and titanium sulfide, or by hydrolysis and dehydration-condensation of an organic titanium compound, in the presence of an acid, such as tetraethoxytitanium, tetraisopropoxytitanium, tetra-n-propoxytitanium, tetrabutoxytitanium or tetramethoxytitanium. Then, it is denatured into an anatase type titania by baking at 400°C to 500°C, and may be denatured into a rutile type titania by baking at 600°C to 700°C.

[0080]

In the case of using a binder in the photocatalyst containing layer, it is preferable to use those having high bonding energy so that their principal skeletons are not decomposed by the photo-excitation of the photocatalyst. For example, an organopolysiloxane to be explained in detail later regarding the section of the wettability variable layer of the property variable layer can be cited.

[0081]

As mentioned above, when the organopolysiloxane is used

as the binder, the photocatalyst containing layer may be formed by dispersing the photocatalyst and the organopolysiloxane as the binder together with other additives, as needed, into a solvent to prepare a coating solution, and by coating the coating solution to a base material. As the solvent to be used, an alcohol type organic solvent such as ethanol or isopropanol is preferable. The coating solution may be coated by a known coating method such as a spin coating, spray coating, dip coating, roll coating or beads coating. In a case where an ultraviolet curing type component is contained as the binder, the photocatalyst containing layer may be formed by irradiating ultraviolet rays to carry out curing treatment.

[0082]

Further, amorphous silica precursor can be used as the binder. The precursor of this amorphous silica is represented by the formula SiX_4 wherein X represents a halogen, a methoxy group, an ethoxy group, or an acetyl group, silanols which are hydrolysates of these, or polysiloxanes having an average molecular weight of 3000 or less are preferable.

[0083]

As specific examples, tetraethoxysilane, tetraisopropoxysilane, tetra-n-propoxysilane, tetrabutoxysilane, and tetramethoxysilane can be cited. In this case, amorphous silica precursor and photocatalyst particles are dispersed uniformly in a nonaqueous solvent, hydrolyzed with moisture in the air to form silanol on the base material. Subsequently dehydration-condensation polymerization is carried out at room temperature to form a photocatalyst containing layer. The polymerization degree of

the silanol can be made higher and the strength of the film surface can be enhanced when dehydration-condensation polymerization is carried out at a temperature 100 °C or higher. Further, the binding agent can be used alone or by a mixture of two or more.

[0084]

The content of the photocatalyst in the photocatalyst containing layer used when the binder is used may be set to be in a range of 5 to 60% by weight and preferably 20 to 40% by weight. Also, the thickness of the photocatalyst containing layer is preferably in a range of 0.05 to 10 μm .

[0085]

Further, apart from the photocatalyst and the binder, a surfactant may be used in the photocatalyst containing layer. Examples of such a decomposable material may include surfactants which are decomposed by an action of the photocatalyst and has a function to change the wettability of the surface of the photocatalyst containing layer by being decomposed. Specifically, nonionic surfactants of hydrocarbon types such as each series of NIKKOL BL, BC, BO and BB manufactured by Nikko Chemicals Co., Ltd., fluorine types such as ZONYL FSN and FSO manufactured by Du Pont Kabushiki Kaisha, SURFLON S-141 and 145 manufactured by Asahi Glass Company, MEGAFACE F-141 and 144 manufactured by Dainippon Ink and Chemicals, Incorporated, FTARGET F-200 and F251 manufactured by NEOS Co., Ltd., UNIDYNE DS-401 and 402 manufactured by DAIKIN INDUSTRIES, LTD., and FLUORAD FC-170 and 176 manufactured by 3M, and silicone type surfactants can be listed. Cationic surfactants, anionic surfactants and amphoteric surfactants may also be used.

[0086]

Besides the surfactants, oligomers and polymers such as a polyvinyl alcohol, unsaturated polyester, acryl resin, polyethylene, diallyl phthalate, ethylenepropylenediene monomer, epoxy resin, phenol resin, polyurethane, melamine resin, polycarbonate, polyvinyl chloride, polyamide, polyimide, styrenebutadiene rubber, chloroprene rubber, polypropylene, polybutylene, polystyrene, polyvinyl acetate, nylon, polyester, polybutadiene, polybenzimidazole, polyacrylonitrile, epichlorohydrin, polysulfide, polyisoprene, and the like can be contained in the photocatalyst containing layer.

[0087]

(Base material)

In the present invention, as shown in FIG. 1, the photocatalyst containing layer side substrate 3 is provided with at least the base material 1 and the photocatalyst containing layer 2 formed on the base material 1.

[0088]

In this case, the material constituting the base material to be used is selected properly according to, for example, the direction of energy irradiation in the below mentioned property variable pattern forming process and depending on whether or not a resulting conductive pattern forming body requires transparency.

[0089]

That is, when the conductive pattern forming body uses an opaque material such as a paper base phenol resin laminate as the base material, energy is inevitably irradiated from the direction of the photocatalyst containing layer side substrate

side. As shown in FIG. 1b, it is necessary that a photomask 7 is placed on the photocatalyst containing layer side substrate 3 side energy irradiation. Also, when a photocatalyst containing layer side light shielding part is formed in a predetermined pattern in advance on the photocatalyst containing layer side substrate to form a property variable pattern by using the photocatalyst containing layer side light shielding part as will be described later, energy must be irradiated from the photocatalyst containing layer side substrate side. In such a case, the base material must have transparency.

[0090]

In the meantime, when the conductive pattern forming body is, for example, a transparent resin film, a photomask may be placed on the pattern forming body substrate side for energy irradiation. Also, as will be described later, when a pattern forming body side light shielding part is formed in this pattern forming body substrate, energy must be irradiated from the pattern forming body substrate side. In such a case, the transparency of the base material is not particularly required.

[0091]

Also, the base material to be used in the present invention may be those having flexibility, for example, a resin film, or may be those having no flexibility, for example, a glass substrate. This is properly selected according to the method of energy irradiation in the below mentioned property variable pattern forming process.

[0092]

As mentioned above, although the material of the base

material used for the photocatalyst containing layer side substrate in the present invention is not particularly limited, a material which has a predetermined strength and the surface of which is highly adhesive to the photocatalyst containing layer is preferably used because the photocatalyst containing layer side substrate in the present invention is used repeatedly.

[0093]

Specific examples of such a material may include glass, ceramics, metals and plastics.

[0094]

An anchor layer may be formed on the base material to improve the adhesion between the surface of the base material and the photocatalyst containing layer. Examples of materials used for the anchor layer may include silane type and titan type coupling agents.

[0095]

(Photocatalyst containing layer side light shielding part)

As the photocatalyst containing layer side substrate used in the present invention, a substrate provided with a photocatalyst containing layer side light shielding part formed in a pattern may be used. When the photocatalyst containing layer side substrate provided with such a photocatalyst containing layer side light shielding part is used, it is not necessary to use a photomask when the substrate is irradiated with energy and it is also not necessary to carry out laser beam drawing irradiation. Therefore, because the alignment of the photocatalyst containing layer side substrate with a photomask is not necessary, the process can be simple. Also, because a

costly device required for drawing irradiation is not necessary, there is a merit that it is advantageous in light of cost.

[0096]

There are two configurations of the photocatalyst containing layer side substrate provided with such a photocatalyst containing layer side light shielding part, according to the position where the photocatalyst containing layer side light shielding part is formed.

[0097]

In one configuration, as shown in FIG. 3, a photocatalyst containing layer side light shielding part 13 is formed on a base material 1, and a photocatalyst containing layer 2 is formed on the photocatalyst containing layer side light shielding part 3 to form a photocatalyst containing layer side substrate 3. In another configuration, as shown in FIG. 4, a photocatalyst containing layer 2 is formed on a base material 1, and a photocatalyst containing layer side light shielding part 13 is formed thereon to form a photocatalyst containing layer side substrate 3.

[0098]

In either configuration, because the photocatalyst containing layer side light shielding part is placed near the part where the photocatalyst containing layer and the property variable layer are contacted or faced to each other, the influence of the scattering energy in the base material and the like can be reduced as compared with the case of using a photomask, therefore, pattern irradiation of energy can be carried out with outstandingly high precision.

[0099]

Also, in the configuration in which the photocatalyst containing layer side light shielding part is formed on the photocatalyst containing layer, this has the advantage that when the photocatalyst containing layer and the property variable layer are placed at predetermined positions, in a case where it is preferable to place the both with a predetermined gap as will be described later, the photocatalyst containing layer side light shielding part may be used as a spacer making the above gap even by making the layer thickness of the photocatalyst containing layer side light shielding part coinciding to the width of the gap.

[0100]

That is, when the photocatalyst containing layer and the property variable layer are placed in the condition that the both are in contact with or facing to each other with a predetermined gap, by placing the photocatalyst containing layer side light shielding part and the property variable layer in a closely contact state, the above mentioned predetermined gap can be made precisely, and by irradiating energy from the photocatalyst containing layer side substrate in this condition, a property variable pattern can be formed on the property variable layer with high accuracy.

[0101]

Methods for forming such a photocatalyst containing layer side light shielding part is not particularly limited, and an appropriate method is selected and used according to the properties of the surface on which the photocatalyst containing layer side light shielding part is formed or to the necessary shielding properties from energy.

[0102]

For example, a thin film of a metal such as chromium may be formed in a thickness of about 1000 to 2000 Å by using a sputtering method or vacuum deposition method and then by patterning to form the light shielding part. As this patterning method, usual patterning methods such as sputtering may be used.

[0103]

Also, a method may be adopted in which a layer containing light shielding particles such as a carbon fine particle, metal oxide, inorganic pigment, and organic pigment, in a resin binder is formed in a pattern. As the resin binder to be used, one kind or a mixture of two or more kinds of resins such as a polyimide resin, acryl resin, epoxy resin, polyacrylamide, polyvinyl alcohol, gelatin, casein and cellulose, or photosensitive resins, or further, O/W emulsion type resin compositions, for example, emulsified reactive silicone may be used. The thickness of such resin light shielding part may be set in a range of 0.5 to 10 µm. As a method of patterning such a resin light shielding part, usually used methods such as a photolithographic method and printing method may be used.

[0104]

As the position where the photocatalyst containing layer side light shielding part is formed in the above explanations, two cases, namely the case where it is placed in between the base material and the photocatalyst containing layer, and the case where it is placed on the surface of the photocatalyst containing layer are explained. However, besides the above configurations, it is possible to adopt a configuration in which the photocatalyst containing layer side light shielding part

is formed on the surface of the base material on the side on which the photocatalyst containing layer is not formed. In this configuration, for example, there is a case where a photomask is brought into close contact with the surface to the extent that the photomask is removable, and this configuration may be preferably used in a case of changing the property variable pattern in a small lot.

[0105]

(Primer layer)

Next, the primer layer used for the photocatalyst containing layer side substrate in the present invention will be explained. In the present invention, the primer layer may be formed in between the photocatalyst containing layer side light shielding part and the photocatalyst containing layer, when the photocatalyst containing layer side light shielding part is formed in a pattern on the base material and the photocatalyst containing layer is formed thereon to form the photocatalyst containing layer side substrate.

[0106]

Although the action and function of the primer layer are not necessarily clear, it is considered, by forming the primer layer in between the photocatalyst containing layer side light shielding part and the photocatalyst containing layer, the primer layer exhibits the function of preventing the diffusion of impurities deriving from the photocatalyst containing layer side light shielding part and an opening existing in between the photocatalyst containing layer side light shielding parts, particularly impurities such as residues, metals and metal ions, which occur when the photocatalyst containing layer side light

shielding part is patterned, which cause the inhibition of a property change of the property variable layer by an action of the photocatalyst. Therefore, by forming the primer layer, a property changing treatment will proceed in high sensitivity, as a result, a pattern with high resolution can be obtained.

[0107]

As the primer layer in the present invention prevents the action of the photocatalyst from being affected by the impurities deriving from not only the photocatalyst containing layer side light shielding part but also an opening existing in between the photocatalyst containing layer side light shielding parts, the primer layer is preferably formed on the entire surface of the photocatalyst containing layer side light shielding part including the opening.

[0108]

FIG. 5 is a view showing one example of the photocatalyst containing layer side substrate formed with such a primer layer. A primer layer 14 is formed on a base material 1, on which a photocatalyst containing layer side light shielding part 13 of the photocatalyst containing layer side substrate 3 is formed, on the surface of the side on which the photocatalyst containing layer side light shielding part 13 is formed. A photocatalyst containing layer 2 is formed on the surface of the primer layer 14.

[0109]

The primer layer in the present invention is not particularly limited as long as the photocatalyst containing layer side substrate has a structure in which the primer layer is formed such that the photocatalyst containing layer side

light shielding part is not in contact with the photocatalyst containing layer.

[0110]

The material constituting the primer layer is preferably, though not particularly limited to, inorganic materials which are scarcely decomposed by an action of the photocatalyst. Specifically, amorphous silica can be listed. When such amorphous silica is used, the precursor of this amorphous silica is silicon compounds represented by the formula SiX_4 wherein X represents a halogen, a methoxy group, an ethoxy group, or an acetyl group, silanols which are hydrolysates of these, or polysiloxanes having an average molecular weight of 3000 or less are preferable.

[0111]

Also, the layer thickness of the primer layer is preferably in a range of 0.001 μm to 1 μm , and particularly preferably in a range of 0.001 μm to 0.1 μm .

[0112]

(2) Pattern forming body substrate preparing process

Next, in the present invention, a pattern forming body substrate preparing process is carried out, wherein a pattern forming body substrate having a property variable layer whose property of the surface is changed by an action of the photocatalyst in the aforementioned photocatalyst containing layer is prepared. The pattern forming body substrate prepared in this process is not particularly limited as long as it is provided with at least a property variable layer whose property of the surface is changed by an action of the photocatalyst in the above photocatalyst containing layer. When the property

variable layer has a self-supporting ability, it may be made only of the property variable layer, whereas when the property variable layer has not self-supporting ability, the property variable layer may be formed on a base body. Also, the pattern forming body substrate may be provided with a light shielding part and the like therein. Each structure of the pattern forming body substrate forming process will be hereinafter explained.

[0113]

(Property variable layer)

First, the property variable layer used for the pattern forming body substrate in the present invention will be explained. As the property variable layer used for the pattern forming body substrate in the present invention is not particularly limited as long as the properties of its surface are changed by an action of the photocatalyst contained in the aforementioned photocatalyst containing layer. However, in the present invention, particularly two cases, namely the case where the property variable layer is a wettability variable layer wherein the wettability is changed by an action of the photocatalyst to form a wettability pattern, and the case where the property variable layer is a decomposition removal layer which is decomposed and removed by an action of the photocatalyst to form a pattern of irregularity, are preferable because the effectiveness of the present invention is more drawn out in relation to, particularly, the resulting property variable pattern and the like.

These wettability variable layer and decomposition removal layer will be hereinafter explained.

[0114]

a. Wettability variable layer

Any layer whose wettability of the surface is changed by an action of the photocatalyst may be used as the wettability variable layer in the present invention without any particular limitation. However, the wettability variable layer is usually preferably a layer whose wettability is changed so as a contact angle of the surface of the wettability variable layer to a liquid is reduced by an action of the photocatalyst by energy irradiation.

[0115]

This is because by accordingly forming the wettability variable layer whose wettability is changed so as a contact angle to a liquid is reduced by energy irradiation, the wettability can be changed into a pattern with ease and a pattern of a lyophilic area having a small contact angle to a liquid can be formed by irradiating with energy, for example, in a case of using a photomask, in a case of using the photocatalyst containing layer side light shielding part, and in a case of forming the photocatalyst containing layer in a pattern as aforementioned. Therefore, the conductive pattern forming body can be manufactured efficiently, which is economically advantageous.

[0116]

Here, the lyophilic area means an area having a small contact angle to a liquid and high wettability to the below mentioned metal colloid. On the other hand, the liquid repellent area means an area having a large contact angle to a liquid and low wettability to the metal colloid.

[0117]

The contact angle of the wettability variable layer to the metal colloid is preferably 50° or more, more preferably 60° or more, and particularly preferably 70° or more, in a part where energy is not irradiated, namely the liquid repellent area. This reason is that since the part where energy is not irradiated is a part for which liquid repellency is required in the present invention, the liquid repellency is not sufficient when the contact angle to a liquid is small, and in a case of coating the metal colloid on the entire surface in the below mentioned metal colloid coating process, the possibility of the metal colloid being left also in an area where no conductive pattern is formed, which is undesirable.

[0118]

Also, the contact angle of the wettability variable layer to a metal colloid is preferably 40° or less, more preferably 30° or less, and particularly preferably 20° or less, in a part where energy is irradiated, namely the lyophilic area. This reason is that in a case where the contact angle to the metal colloid is high in a part where energy is irradiated, namely the lyophilic area, there is the possibility of the metal colloid being repelled even in the lyophilic area when coating the metal colloid as will be described later, and there is the possibility of being difficult to pattern the lyophilic area with the metal colloid.

[0119]

The contact angle to a liquid meant here was obtained in the following manner: the contact angles of the subject material to liquids having different surface tensions were measured (measured 30 seconds after liquid droplets are dripped from a

micro-syringe) using a contact angle measuring device (CA-Z model, manufactured by Kyowa Interface Science Co., LTD.) to obtain the contact angle from the results of measurement or by making a graph based on these results. In this measurement, as the liquids having different surface tensions, wetting index standard solutions manufactured by JUNSEI CHEMICAL CO., LTD.) were used.

[0120]

Also, when the wettability variable layer is used in the present invention, fluorine is contained in the wettability variable layer, and further, the wettability variable layer may be formed such that the fluorine content in the surface of the wettability variable layer is reduced by an action of the photocatalyst when energy is irradiated to the wettability variable layer, as compared to that before energy irradiation.

[0121]

The wettability variable layer having such properties makes it possible to form a pattern, comprising a part with low fluorine content, with ease by pattern irradiation of energy as will be described later. Here, fluorine has an extremely low surface energy, and therefore, the surface of a substance containing a lot of fluorine has lower critical surface tension. Therefore, the critical surface tension of the surface of a part having small fluorine content is larger than that of the surface of a part having large fluorine content. This specifically means that the part having small fluorine content is a more lyophilic area than the part having large fluorine content. As a consequence, the formation of a pattern comprising a part having smaller fluorine content than the surrounding surface

leads to the result that a pattern comprising a lyophilic area is formed in a liquid repellent area.

[0122]

Therefore, in a case of using such a wettability variable layer, a pattern of lyophilic area can be easily formed in liquid repellent area by pattern irradiation of energy. Therefore, even in a case of coating the metal colloid on the entire surface, the metal colloid can be adhered only to this lyophilic area to make a conductive pattern forming body with ease and therefore, a highly precise conductive pattern can be formed at a low cost.

[0123]

As regards the fluorine content contained in the above-mentioned wettability variable layer containing fluorine, the fluorine content of the low fluorine content lyophilic area which is formed by energy irradiation, is preferably 10 or less, more preferably 5 or less, and particularly preferably 1 or less when the fluorine content of the non-energy irradiated part is defined as 100.

[0124]

This is because a large difference in lyophilic properties between an energy irradiated part and a non-energy irradiated part can be caused by setting the fluorine content in the above range. Therefore by forming the conductive pattern on such wettability variable layer, a conductive pattern can be precisely formed only in the lyophilic area where fluorine content is reduced, and the conductive pattern forming body can be obtained with high precision. It is to be noted that the reducing rate is on a weight basis.

[0125]

The fluorine content in the wettability variable layer may be measured by various methods which are generally used. It is not particularly limited as long as it is a method which can measure the quantity of fluorine on the surface quantitatively, for example, an X-ray photoelectron spectroscopy, ESCA (also called Electron Spectroscopy for Chemical Analysis), fluorescent X-ray analysis, and mass spectrometry.

[0126]

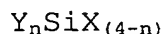
As a material for the wettability variable layer, it is not particularly limited as long as the material changes the property of the wettability variable layer, i.e., the wettability, by the action of the photocatalyst contained in the photocatalyst containing layer to which the layer contacts or faces by the energy irradiation and as long as the material has a principal chain which is not easily deteriorated or decomposed by the action of the photocatalyst. organopolysiloxanes can be cited as an example. In the present invention, an organopolysiloxane having a fluoroalkyl group is preferable among organopolysiloxanes.

[0127]

Examples of the organopolysiloxanes may include (1) organopolysiloxanes which are obtained by hydrolysis and polymerization-condensation of chloro or alkoxysilane or the like by sol-gel reactions and exhibit high strength and (2) organopolysiloxanes obtained by crosslinking reactive silicones which are excellent in water repellency and oil repellency.

[0128]

In a case of the above (1), organopolysiloxanes which are hydrolysis condensates or co-hydrolysis condensates of one kind or two or more kinds of silicon compounds represented by the following formula are preferable.

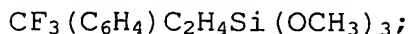
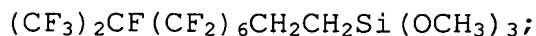
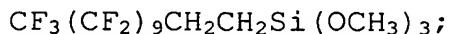
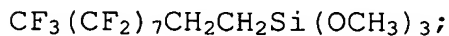
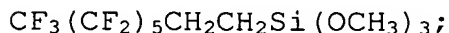
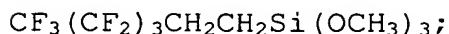


(Wherein Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group, an acetyl group or a halogen and "n" denotes an integer from 0 to 3.) Here, the number of carbon atoms in the group represented by Y is preferably in a range of 1 to 20, and the alkoxy group represented by X is preferably a methoxy group, an ethoxy group, a propoxy group or a butoxy group.

[0129]

Also, as the binder, polysiloxanes containing a fluoroalkyl group are particularly preferably used. Specifically, hydrolysis condensates or co-hydrolysis condensates of one kind or two or more kinds of the following fluoroalkylsilanes can be listed. Those generally known as fluorine type silane coupling agents may be used.

[0130]



$\text{CF}_3(\text{CF}_2)_3(\text{C}_6\text{H}_4)\text{C}_2\text{H}_4\text{Si}(\text{OCH}_3)_3;$
 $\text{CF}_3(\text{CF}_2)_5(\text{C}_6\text{H}_4)\text{C}_2\text{H}_4\text{Si}(\text{OCH}_3)_3;$
 $\text{CF}_3(\text{CF}_2)_7(\text{C}_6\text{H}_4)\text{C}_2\text{H}_4\text{Si}(\text{OCH}_3)_3;$
 $\text{CF}_3(\text{CF}_2)_3\text{CH}_2\text{CH}_2\text{SiCH}_3(\text{OCH}_3)_2;$
 $\text{CF}_3(\text{CF}_2)_5\text{CH}_2\text{CH}_2\text{SiCH}_3(\text{OCH}_3)_2;$
 $\text{CF}_3(\text{CF}_2)_7\text{CH}_2\text{CH}_2\text{SiCH}_3(\text{OCH}_3)_2;$
 $\text{CF}_3(\text{CF}_2)_9\text{CH}_2\text{CH}_2\text{SiCH}_3(\text{OCH}_3)_2;$
 $(\text{CF}_3)_2\text{CF}(\text{CF}_2)_4\text{CH}_2\text{CH}_2\text{SiCH}_3(\text{OCH}_3)_2;$
 $(\text{CF}_3)_2\text{CF}(\text{CF}_2)_6\text{CH}_2\text{CH}_2\text{SiCH}_3(\text{OCH}_3)_2;$
 $(\text{CF}_3)_2\text{CF}(\text{CF}_2)_8\text{CH}_2\text{CH}_2\text{SiCH}_3(\text{OCH}_3)_2;$
 $\text{CF}_3(\text{C}_6\text{H}_4)\text{C}_2\text{H}_4\text{SiCH}_3(\text{OCH}_3)_2;$
 $\text{CF}_3(\text{CF}_2)_3(\text{C}_6\text{H}_4)\text{C}_2\text{H}_4\text{SiCH}_3(\text{OCH}_3)_2;$
 $\text{CF}_3(\text{CF}_2)_5(\text{C}_6\text{H}_4)\text{C}_2\text{H}_4\text{SiCH}_3(\text{OCH}_3)_2;$
 $\text{CF}_3(\text{CF}_2)_7(\text{C}_6\text{H}_4)\text{C}_2\text{H}_4\text{SiCH}_3(\text{OCH}_3)_2;$
 $\text{CF}_3(\text{CF}_2)_3\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_2\text{CH}_3)_3;$
 $\text{CF}_3(\text{CF}_2)_5\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_2\text{CH}_3)_3;$
 $\text{CF}_3(\text{CF}_2)_7\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_2\text{CH}_3)_3;$
 $\text{CF}_3(\text{CF}_2)_9\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_2\text{CH}_3)_3;$
 $\text{CF}_3(\text{CF}_2)_7\text{SO}_2\text{N}(\text{C}_2\text{H}_5)\text{C}_2\text{H}_4\text{CH}_2\text{Si}(\text{OCH}_3)_3$
 [0131]

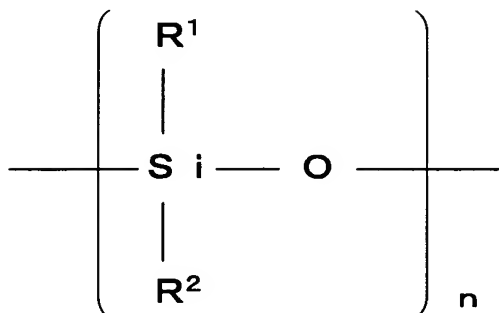
By using the above-mentioned polysiloxanes containing a fluoroalkyl group as the binder, the liquid repellency of a non-energy irradiated part of the wettability variable layer is greatly improved and exhibits the function of preventing the adhesion of the metal colloid when the metal colloid is coated on the entire surface. Thereby, it is made possible to adhere the metal colloid only to the lyophilic area which is an energy-irradiated part.

[0132]

Also, as the reactive silicone of the above (2), compounds having a skeleton represented by the following formula can be listed.

[0133]

[Chemical Formula 1]



[0134]

wherein "n" is an integer of 2 or more, R¹ and R² each represent a substituted or unsubstituted alkyl, alkenyl, aryl or cyanoalkyl group of 1 to 10 carbon atoms; 40% or less by mol ratio to the whole is vinyl, phenyl and phenyl halide. Also, R¹ and R² are preferably a methyl group because the surface energy is the lowest, and 60% or more by mol ratio is preferably a methyl group. Also, these compounds have at least one reactive group such as a hydroxyl group in a molecular chain at a chain terminal or side chain.

[0135]

Also, a stable organosilicon compound which does not crosslink, such as a dimethylpolysiloxane, may be compounded in the binder, together with the above organopolysiloxane.

[0136]

As explained, various materials such as the organopolysiloxane can be used for the wettability variable layer. It is effective in wettability pattern formation for

the wettability variable layer to contain fluorine as explained above. It is therefore preferable for the wettability variable layer to contain a material which is not easily deteriorated or decomposed by the action of the photocatalyst. Specifically preferable for the wettability variable layer is to contain fluorine in the organopolysiloxane material.

[0137]

Examples of a method of compounding fluorine in the organopolysiloxane material may include a method in which a fluorine compound is bound to a main agent usually having a high bonding energy with relatively weak bonding energy, and a method in which a fluorine compound, which is bound with relatively weak bonding energy, is mixed into the wettability variable layer. This is because the introduction of fluorine by such a method ensures that the fluorine-bound part having relatively small bonding energy is first decomposed, whereby fluorine can be removed from the wettability variable layer when energy is irradiated.

[0138]

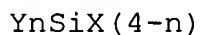
The above mentioned first method, namely, a method in which a fluorine compound is bound to the binder, having high bonding energy, with relatively weak bonding energy may include a method in which a fluoroalkyl group is introduced as a substituent into the above organopolysiloxane.

[0139]

For example, as a method for obtaining an organopolysiloxane, as described in the above (1), an organopolysiloxane exhibiting high strength may be obtained by hydrolysis and polymerization-condensation of chloro or

alkoxysilane or the like by sol-gel reaction.

Here, in this method, as aforementioned, the organopolysiloxane is obtained by hydrolysis condensation or co-hydrolysis condensation of one kind or two or more kinds of silicon compounds represented by the above formula, that is;



(Wherein Y represents an alkyl group, a fluoroalkyl group, a vinyl group, an amino group, a phenyl group or an epoxy group, X represents an alkoxyl group, an acetyl group or a halogen and "n" denotes an integer from 0 to 3.) In the formula, by synthesizing using a silicon compound having a fluoroalkyl group as the substituent Y, an organopolysiloxane having a fluoroalkyl group as a substituent can be obtained. When such an organopolysiloxane having a fluoroalkyl group as the substituent is used as the binder, since the part of carbon bonding of the fluoroalkyl group is decomposed by an action of the photocatalyst, it is possible to decrease the fluorine content of the part irradiated with energy on the surface of the wettability variable layer.

[0140]

Although silicon compound having an fluoroalkyl group used in this case is not particularly limited as long as it has a fluoroalkyl group, silicon compounds which have at least one fluoroalkyl group and the number of the carbon atoms of this fluoroalkyl group is 4 to 30, preferably 6 to 20, and particularly preferably 6 to 16, are preferably used. Specific examples of such a silicon compound are as aforementioned. However, among the above, silicon compounds having fluoroalkyl group whose number of carbon atoms is 6 to 8, namely,

fluoroalkylsilanes are preferable.

[0141]

In the present invention, such a silicon compound having a fluoroalkyl group may be used as a mixture with the above mentioned silicon compound having no fluoroalkyl group, and a co-hydrolysis condensate of these may be used as the above organopolysiloxane. Using one kind or two or more kinds of such silicon compounds having a fluoroalkyl group, hydrolysis condensates or co-hydrolysis condensates of these may be used as the above organopolysiloxane.

[0142]

In accordingly obtained organopolysiloxane having a fluoroalkyl group, among the silicon compound constituting this organopolysiloxane, the silicon compound having a fluoroalkyl group is preferably contained by 0.01 mol% or more, and more preferably 0.1 mol% or more.

[0143]

This reason is that when the fluoroalkyl group is contained to the above extent, the liquid repellency of the wettability variable layer can be improved and it is therefore possible to increase a difference in wettability from the part made to be a lyophilic area by irradiating energy.

[0144]

Also, in the method shown in the above (2), an organopolysiloxane is obtained by crosslinking reactive silicone having high liquid repellency. In this case, similarly, one or both of R1 and R2 in the above formula are a substituent containing a fluorine such as a fluoroalkyl group whereby fluorine can be compounded in the wettability variable

layer. Also, when energy is irradiated, the part of the fluoroalkyl group, of which the bonding energy is smaller than the siloxane bonding, is decomposed, and it is therefore, possible to decrease the fluorine content on the surface of the wettability variable layer by energy irradiation.

[0145]

In the meantime, the latter example, that is, the method of introducing a fluorine compound which is bound with energy lower than the bonding energy of the binder include a method in which a fluorine type surfactant is mixed as the decomposable material as mentioned above. Also, as a method for introducing a high molecular weight fluorine compound, a method in which a fluoro resin having high compatibility to a binder resin is mixed, can be listed.

[0146]

The wettability variable layer of the present invention can further comprise a surfactant. Examples of such a decomposable material may include surfactants which are decomposed by an action of the photocatalyst and has a function to change the wettability of the surface of the photocatalyst containing layer by being decomposed. Specifically, nonionic surfactants of hydrocarbon types such as each series of NIKKOL BL, BC, BO and BB manufactured by Nikko Chemicals Co., Ltd., fluorine types such as ZONYL FSN and FSO manufactured by Du Pont Kabushiki Kaisha, SURFLON S-141 and 145 manufactured by Asahi Glass Company, MEGAFACE F-141 and 144 manufactured by Dainippon Ink and Chemicals, Incorporated, FTARGET F-200 and F251 manufactured by NEOS Co., Ltd., UNIDYNE DS-401 and 402 manufactured by DAIKIN INDUSTRIES, LTD., and FLUORAD FC-170 and

176 manufactured by 3M, and silicone type surfactants can be listed. Cationic surfactants, anionic surfactants and amphoteric surfactants may also be used.

[0147]

Besides the surfactants, oligomers and polymers such as a polyvinyl alcohol, unsaturated polyester, acryl resin, polyethylene, diallyl phthalate, ethylenepropylenediene monomer, epoxy resin, phenol resin, polyurethane, melamine resin, polycarbonate, polyvinyl chloride, polyamide, polyimide, styrenebutadiene rubber, chloroprene rubber, polypropylene, polybutylene, polystyrene, polyvinyl acetate, nylon, polyester, polybutadiene, polybenzimidazole, polyacrylonitrile, epichlorohydrin, polysulfide, polyisoprene, and the like can be contained in the wettability variable layer.

[0148]

The wettability variable layer may be formed by dispersing the above-mentioned component together with other additives, as needed, into a solvent to prepare a coating solution, and by coating the coating solution to a base body. As the solvent to be used, an alcohol type organic solvent such as ethanol or isopropanol is preferable. The coating solution may be coated by a known coating method such as a spin coating, spray coating, dip coating, roll coating or beads coating. In a case where an ultraviolet curing type component is contained as the binder, the wettability variable layer may be formed by irradiating ultraviolet rays to carry out curing treatment.

[0149]

Also, the wettability variable layer used in present invention may be formed of a material having either

self-supporting ability or no self-supporting ability, if it is formed of a material whose wettability of the surface can be changed by an action of the photocatalyst. In present invention, "having self-supporting ability" means that it can exist in a concrete state without any supporting material.

[0150]

When the wettability variable layer is made of a material having self-supporting ability, commercially available resin films made of, for example, materials which can be made into the wettability variable layer, may be used and this is advantageous in light of cost. As such a material, the aforementioned materials formed into a film may be used if they have self-supporting ability. Examples of such a material may include a polyethylene, polycarbonate, polypropylene, polystyrene, polyester, polyvinyl fluoride, acetal resin, nylon, ABS, PTFE, methacryl resin, phenol resin, polyvinylidene fluoride, polyoxymethylene, polyvinyl alcohol, polyvinyl chloride, polyethylene terephthalate, and silicone.

[0151]

In present invention, the wettability variable layer preferably has no self-supporting ability. This is because the wettability variable layers formed of the above mentioned material whose property is largely changed are usually a material not having self-supporting ability, and therefore, by forming on a base material, strength and the like are increased and can be used for various pattern forming bodies.

[0152]

Though the wettability variable layer used in present invention is not particularly limited as long as it is a layer

whose wettability is changed by an action of the photocatalyst as aforementioned, a layer containing no photocatalyst is particularly preferable. This is because if no catalyst is contained in the wettability variable layer, there is no need to worry about the influence of the photocatalyst with time, and it is therefore, possible to use it without any problem for a long period of time when it is used as a functional element.

[0153]

In present invention, the thickness of the wettability variable layer is preferably in a range of 0.001 μm to 1 μm , and particularly preferably in a range of 0.01 to 0.1 μm , in relation to the rate of change in wettability caused by the photocatalyst.

[0154]

In present invention, by the use of the wettability variable layer having the aforementioned components, the wettability of an energy irradiated part is changed to be a lyophilic area by utilizing the effects of oxidation and decomposition, by an action of the photocatalyst contained in the photocatalyst containing layer which is in contact with or facing to, of organic groups which are a part of the above components, making it possible to produce a large difference in wettability from the non-energy irradiated part. As a consequence, it is possible to adhere the metal colloid only to the lyophilic area which is the part irradiated with energy with ease, also in a case of coating the metal colloid to the entire surface as will be described later, and a highly precise conductive pattern forming body can be manufactured at a low cost.

[0155]

b. Decomposition removal layer

Next, the decomposition removal layer will be explained. There is no particular limitation to the decomposition removal layer used in present invention as long as a part of the decomposition removal layer which is irradiated with energy is decomposed and removed by an action of the photocatalyst contained in the photocatalyst containing layer when irradiated with energy.

[0156]

As aforementioned, since a part of the decomposition removal layer which is irradiated with energy is decomposed and removed by an action of the photocatalyst, it is possible to form a pattern comprising a part where the decomposition removal layer is present and a part where the decomposition removal layer is not present, that is, a pattern having irregularity, without carrying out a developing process or a cleaning process.

[0157]

Although this decomposition removal layer is removed without carrying out any particular after treatment such as a developing process and cleaning process because it is, for example, oxidation decomposed and vaporized by an action of the photocatalyst by energy irradiation, a cleaning process and the like may be carried out depending on the material of the decomposition removal layer.

[0158]

Also, the decomposition removal layer used in present invention is preferably not only provided with irregularities, but also has a higher contact angle to a liquid than the base

body which will be described later. This is because the decomposition removal layer is thereby decomposed and removed, and an area where the base body is bared can be a lyophilic area and an area where the decomposition removal layer remains can be a liquid repellent area, enabling the formation of various patterns.

[0159]

Here, the lyophilic area means an area having a small contact angle to a liquid and high wettability to the metal colloid which will be described later. On the other hand, the liquid repellent area means an area having a large contact angle to a liquid and low wettability to the metal colloid.

[0160]

Also, the decomposition removal layer preferably has a contact angle to the metal colloid of 50° or more, more preferably 60° or more, and particularly preferably 70° or more. This is because, in the present invention, the remaining decomposition removal layer is the part of which liquid repellency is required, liquid repellency is not sufficient when the contact angle to a liquid is small, when the metal colloid is coated to the entire surface in the below mentioned metal colloid coating process, there is the possibility of the metal colloid being left even in an area where a conductive pattern is not formed, which is not preferable.

[0161]

Also in present invention, a contact angle of the below mentioned base body to the metal colloid is preferably 40° or less, more preferably 30° or less, and particularly preferably 20° or less. This reason is that since the base material is a

part of which lyophilic properties are required in present invention, there is a possibility of the metal colloid being repelled even in the lyophilic area when coating the metal colloid as will be described later, and there is a possibility of being difficult to pattern the lyophilic area with the metal colloid. Here, the contact angle to a liquid is a value measured using the method explained above.

[0162]

In this case, the base body which will be explained later may be surface-treated to make its surface lyophilic. Examples of the surface treatment performed such that the surface of a material is made to be lyophilic include lyophilic surface treatment by means of plasma treatment utilizing argon, water or the like. Examples of the lyophilic layer formed on the base body may include a silica film obtained by a sol gel method using tetraethoxysilane.

[0163]

Specific examples of a layer which may be used as the decomposition removal layer in the present invention may include those made of fluorine type or hydrocarbon type resins having liquid repellency. There is no particular limitation to the fluorine type or hydrocarbon type resins as long as they have liquid repellency. The decomposition removal layer may be formed by dissolving these resins in a solvent and film forming by a usual method such as a spin coating method.

[0164]

Also, in the present invention, a layer free from any defect can be formed by using a functional thin film, that is, a self-assembled monolayer, Langmuir Blodgett film, or

layer-by-layer self-assembled film, therefore, it is preferable to use these film forming methods.

[0165]

Here, a self-assembled monolayer, Langmuir Blodgett film, and layer-by-layer self-assembled film used in present invention will be explained in detail.

[0166]

(i) Self-assembled monolayer

The present inventors have no idea of existence of a formal definition of a self-assembled monolayer. However, as an explanatory text for those recognized generally as a self-assembled monolayer, for example, General Remarks by Abraham Ulman, "Formation and Structure of Self-Assembled Monolayers", Chemical Review, 96, 1533-1554 (1996) is excellent. By referring to this General Remarks, the self-assembled monolayer may be said to be a monolayer produced as a result of the adsorption and bonding (self-assembled) of an appropriate molecule to an appropriate base material. Examples of materials having the ability of forming a self-assembled layer include surfactant molecules such as fatty acids, organic silicon molecules such as alkyltrichlorosilanes and alkylalkoxides, organic sulfur molecules such as alkanethiols, and organic phosphoric acid molecules such as alkyl phosphates. The general point in common of the molecular structure is that they have relatively long alkyl chains and functional groups interacting with the surface of a base material are existing at one molecular terminal. The part of the alkyl chain is a source of intermolecular force when molecules are packed two-dimensionally to each other. Of course, the example shown

here is the simplest structure, and self-assembled monolayers comprising various molecules such as those having an amino group or a carboxyl group at the other terminal of the molecule, those in which the part of alkylene chain is an oxyethylene chain, fluorocarbon chain, or chain of the combined type of these chains are reported. Also, there are complex type self-assembled monolayers comprising plural sorts of molecules. Also, in recent years, there is the case where monolayers in which a layer of polymer, such as particle polymers having plural functional groups (one functional group in some cases) those represented by a dendrimer, or straight-chain polymer (with branching structure in some cases), is formed on a base material surface is considered to be self-assembled monolayers (the latter is generically called a polymer brush). In this embodiment, these are included in the self-assembled monolayers, also.

[0167]

(ii) Langmuir Blodgett film

The Langmuir Blodgett film used in present invention dose not differ greatly in shape from the aforementioned self-assembled monolayer once it is formed on a base material. It may be said that the Langmuir Blodgett film is characterized by its forming method and highly two-dimensional molecular packing properties (high orientation properties and high orderly properties) due to the forming method. That is, the Langmuir Blodgett film forming molecule is generally developed first on a vapor-liquid interface. The developed film is condensed by a trouph and transformed into a highly packed condensed film. Actually, this condensed film is transferred to a proper base material when used. These measures outlined

here make it possible to form films ranging from a monolayer to a multilayer film comprising desired molecular layers. Also, not only low molecules but also high molecules and colloid particles may be used as film materials. Current examples of which various materials are used are described in detail in General Remarks by MIYASHITA Tokuji, "Prospects for Nano-technologies by Creation of Soft type Nano-devices" Polymer, Vol 50, September issue, 644-647 (2001).

[0168]

(iii) Layer-by-layer self-assembled film

Layer-by-layer self-assembled film is a layer which is generally formed by adsorbing and binding at least two materials comprising a functional group comprising a positive or negative charge sequentially to a base material to laminate these materials. Ionic polymers (polymer electrolytes) are frequently used as materials in these days because materials having many functional groups have many advantages such that strength and durability of the layer is improved. Also, particles of proteins, metals, oxides or the like having a surface charge, so-called "colloid particles" are also frequently used as film forming materials. Moreover, films utilizing an interaction weaker than ionic bonds such as a hydrogen bonding, coordinate bonding and hydrophobic interaction have also been recently reported. Relatively recent examples of the layer-by-layer self-assembled film are described in detail in General Remarks by Paula T. Hammond, "Recent Explorations in Electrostatic Multilayer Thin Film Assembly" Current Opinion in Colloid & Interface Science, 4, 430-442 (2000) though slightly inclined towards materials using

electrostatic interaction as driving force. The Layer-by-layer self-assembled film is a film formed by repeating a cycle of adsorption of a material having a positive (negative) charge - cleaning - adsorption of a material having a negative (positive) charge - cleaning, for predetermined times, if explained by the simplest process as an example. Unlike the Langmuir Blodgett film, the development - condensation - transfer operation is not necessary at all. As is clear from the difference between these methods for manufacturing, the layer-layer-self-assembled film is not generally provided with two-dimensional high orientation properties and high orderly properties like the Langmuir Blodgett film. However, the layer-by-layer self-assembled film and its method for manufacturing have many advantages that are not found in conventional film forming methods in the point that an elaborate film free from defects can be easily formed, and the layer-by-layer self-assembled film can be formed evenly on a fine irregular surface, inside surface of a tube, spherical surface and the like.

[0169]

Also, there is no particular limitation to the layer thickness of the decomposition removal layer as long as it is such a level as to be decomposed and removed by irradiated energy in an energy irradiating process which will be described later. Specifically, the thickness is preferably set in a range generally of 0.001 μm to 1 μm , and particularly from 0.01 μm to 0.1 μm , though it differs greatly depending on the type of energy to be irradiated and the material used for the decomposition removal layer.

[0170]

(Base body)

Next, the base body will be explained. In the present invention, the base body is used, for example, when the aforementioned property variable layer has no self-supporting ability or when the property variable layer is a decomposition removal layer. For instance, as shown in FIG. 1a, a property variable layer 5 is provided on a base body 4.

[0171]

Such a base body is properly selected according to, for example, the use purpose of the finally obtained conductive pattern forming body. For example, in a case of usual print boards and the like, materials used generally, specifically, resin laminates of paper base bodies, resin laminates of glass cloth or non-woven glass fabric base bodies, ceramics, and metals may be used. Also, in flexible print boards, flexible resin films may be used as the base body.

[0172]

(Others)

In the present invention, one obtained by forming a pattern forming body substrate side light shielding part in a pattern on a pattern forming body substrate may be used.

[0173]

In this case, because energy must be irradiated from the pattern forming body substrate side in the below mentioned property variable pattern forming process, the aforementioned property variable layer and the base body are preferably formed of transparent materials.

[0174]

Also, in a case where the property variable layer is formed on the base body, it is preferable that the pattern forming body substrate side light shielding part is formed in a pattern on the surface of the base body and the property variable layer is formed thereon. In a case where the property variable layer has self-supporting ability and is not formed on the base body, the pattern forming body substrate side light shielding part is preferably formed on the surface of the property variable layer on the side on which the property variable pattern is not formed.

[0175]

A method of forming such a light shielding part is the same as in a case of the aforementioned photocatalyst containing layer side light shielding part, therefore, explanations are omitted here.

[0176]

(3) Property variable pattern forming process

In the present invention, a property variable pattern forming process is carried out next, wherein the photocatalyst containing layer and the property variable layer are placed at predetermined positions, and then, energy is irradiated from a predetermined direction to form a pattern on the surface of the property variable layer. Each structure of the property variable pattern forming process will be hereinafter explained.

[0177]

(Arrangement of the photocatalyst containing layer and the property variable layer)

In this process, first, when irradiating energy, it is necessary that the photocatalyst containing layer and the

property variable layer are placed such that they are in contact with each other or with a predetermined clearance from each other as to allow the action of the photocatalyst to exert.

[0178]

Here, the term "contact" in the present invention means the condition that is placed such that the action of the photocatalyst is substantially exerted on the surface of the property variable layer, and is a concept including the condition that the photocatalyst containing layer and the property variable layer are placed with a predetermined clearance, besides the condition that the both are physically in contact with each other. This gap is preferably 200 μm or less.

[0179]

The above gap in the present invention is particularly in a range of 0.2 μm to 10 μm , and preferably in a range of 1 μm to 5 μm , taking it into account that extremely high precision pattern is obtained, the sensitivity of the photocatalyst is high, and therefore the efficiency of property change of the property variable layer is improved. Such a range of the gap is particularly effective for a small area conductive pattern forming body in which the gap can be controlled with high precision.

[0180]

On the other hand, in a case of carrying out treatment for a conductive pattern forming body having an area as large as 300 mm \times 300 mm or more, it is very difficult to form a fine gap as aforementioned in between the photocatalyst containing layer side substrate and the pattern forming body substrate so

as not to allow the both to be in contact with each other. For this, when the conductive pattern forming body has a relatively large area, it is preferable that the above gap is preferably in a range of 10 to 100 μm , and particularly in a range of 50 to 75 μm . This is because by setting the gap in such a range, problems of deterioration of pattern accuracy, for example, blurring of a pattern, and the problem that the sensitivity of the photocatalyst is deteriorated so that the efficiency of property variation is reduced, do not arise. And further, there is an effect that an uneven change in the properties of the property variable layer are not caused.

[0181]

When a conductive pattern forming body having relatively large area is irradiated with energy, it is preferable to set the gap in an aligning device used to align the photocatalyst containing layer side substrate and the pattern forming body substrate in an energy irradiating apparatus is preferably in a range of 10 μm to 200 μm , and particularly in a range of 25 μm to 75 μm . This reason is that by setting the value in the above range, a large deterioration in pattern accuracy and a large deterioration in the sensitivity of the photocatalyst is not caused, and the photocatalyst containing layer side substrate and the pattern forming body substrate can be arranged without being in contact with each other.

[0182]

Active oxygen species produced from oxygen and water by an action of the photocatalyst is easily desorbed by placing the photocatalyst containing layer and the surface of the property variable layer with a predetermined clearance. That

is, when the gap between the photocatalyst containing layer and the property variable layer is narrower than the above range, desorption of the above active oxygen species will become difficult, with the result that there is the possibility that the rate of property change is lowered, which is not desirable. Also, when placed with larger clearance than the above range, the produced oxygen species are scarcely reached to the property variable layer, and also in this case, there is the possibility that the rate of property change is lowered, which is not desirable.

[0183]

In the present invention, such a contact or facing condition is to be maintained only at least during energy irradiation.

[0184]

Examples of a method for placing the photocatalyst containing layer and the property variable layer with such an extremely narrow gap evenly formed include a method using a spacer. The use of such a spacer ensures that an even gap can be formed and also, a predetermined property variable pattern can be formed on the property variable layer by making this spacer to have the same pattern as the above property pattern, because the action of the photocatalyst does not reach to the surface of the property variable layer in the part with which the spacer is in contact.

[0185]

In the present invention, such a spacer may be formed into one member. However, for simplifying the process or the like, it is preferably formed on the surface of the photocatalyst

containing layer of the photocatalyst containing layer side substrate as explained in the paragraph of the photocatalyst containing layer side substrate preparing process. In the explanations of the photocatalyst containing layer side substrate preparing process, the spacer is explained as the photocatalyst containing layer side light shielding part. However, in the present invention, it is only required for such a spacer to have the function to protect the surface such that the action of the photocatalyst is not reached on the surface of the property variable layer, and therefore, the spacer may be formed of a material having no ability of shielding irradiated energy, in particular.

[0186]

(Energy irradiation to the contact or facing part)

Next, energy is irradiated to the contact or facing part in the condition that the contact or facing condition is maintained as aforementioned. The term "energy irradiation" (exposure) meant in present invention is a concept including irradiation with any energy ray capable of changing the property of the surface of the property variable layer by the photocatalyst containing layer and is not limited to irradiation with visible light.

[0187]

Generally, the wavelength of the light used for the energy irradiation is preferably set in a range of 400 nm or less, more preferably 380 nm or less. This is because the preferable photocatalyst used in the photocatalyst containing layer is titanium dioxide as aforementioned, and light having the above wavelength is preferable as the energy activating a

photocatalytic action by this titanium dioxide.

[0188]

Examples of a light source used for the energy irradiation may include a mercury lamp, metal halide lamp, xenon lamp, eximer lamp, and other various light sources.

[0189]

A method in which pattern irradiation via a photomask is carried out by using the above mentioned light sources, or a method in which drawing irradiation is carried out in a pattern by using a laser such as an excimer laser or YAG laser, may be used.

[0190]

The amount of energy to be irradiated when energy is irradiated is set to be the irradiating amount required for changing the property of the surface of the property variable layer by an action of the photocatalyst contained in the photocatalyst containing layer.

[0191]

In this case, it is possible to raise sensitivity by irradiating energy while heating the photocatalyst containing layer. This is preferable in the point that the wettability can be changed efficiently. Specifically, the photocatalyst containing layer is preferably to be heated at a temperature in a range of 30°C to 80°C.

[0192]

The direction of energy irradiation in the present invention is decided based on the method for forming a property variable pattern such as whether the photocatalyst containing layer side light shielding part or pattern forming body

substrate side light shielding part is formed or not, or based on whether the photocatalyst containing layer side substrate or pattern forming body substrate is transparent or not.

[0193]

That is, in a case where the photocatalyst containing layer side light shielding part is formed, energy must be irradiated from the photocatalyst containing layer side substrate, and also, in this case, the photocatalyst containing layer side substrate must be transparent to the energy to be irradiated. In this case, also energy may be irradiated either from the photocatalyst containing layer side substrate side or from the pattern forming body substrate side, in a case where the photocatalyst containing layer side light shielding part is formed on the photocatalyst containing layer and this photocatalyst containing layer side light shielding part is used so as to provide a function as a spacer.

[0194]

On the other hand, when the pattern forming body substrate side light shielding part is formed, energy must be irradiated from the pattern forming body substrate side, and also in this case, the pattern forming body substrate must be transparent to the energy to be irradiated. In this case, also, energy may be irradiated either from the photocatalyst containing layer side substrate side or from the pattern forming body substrate side, in a case where the pattern forming body substrate side light shielding part is formed on the property variable layer and this pattern forming body substrate side light shielding part is used so as to provide a function as a spacer.

[0195]

As the direction of energy irradiation in a case where the photocatalyst containing layer is formed in a pattern, energy may be irradiated from any direction as long as it is irradiated to the part where the photocatalyst containing layer and the property variable layer are in contact with or facing to each other.

[0196]

Similarly, in also the case of using the aforementioned spacer, energy may be irradiated from any direction insofar as energy is irradiated to the contact or facing part.

[0197]

When a photomask is used, energy is irradiated from the side on which the photomask is placed. In this case, the substrate on the side on which the photomask is placed. In this case the substrate on the side the photomask is placed, namely, either one of the photocatalyst containing layer side substrate or the pattern forming body substrate must be transparent.

[0198]

(Dismount of the photocatalyst containing layer side substrate)

After the energy irradiation as aforementioned is finished, the photocatalyst containing layer side substrate is separated from the position where it is placed in contact with or with a gap from the property variable layer, to form a property variable pattern comprising a property variable area 9 and a non-property variable area 10 on a property variable layer 5, as shown in FIG. 1d.

[0199]

(4) Metal colloid coating process.

In the present invention, next, a metal colloid coating

process is carried out, wherein the metal colloid is coated to the surface of the pattern forming body substrate on which the aforementioned property variable pattern is formed, to adhere the metal colloid in a pattern.

[0200]

The coating of the metal colloid is not particularly limited as long as the metal colloid can be coated to the surface of the photocatalyst containing layer. Specifically, it may be methods, such as a dip coating method or spin coating method, in which the entire surface of the property variable layer is coated and methods, such as a nozzle discharging method, in which the metal colloid is coated in an intended pattern. Also, among the nozzle discharging methods, ink jet method is preferable in view of high manufacturing efficiency.

[0201]

The viscosity of the metal colloid used in the present invention is preferably in a range of 1 to 100 cps, more preferably 5 to 50 cps, and particularly preferably 10 to 20 cps. The concentration is preferably in a range of 1 to 70 wt%, more preferably 10 to 50 wt%, and particularly preferably 20 to 30 wt%. When the viscosity and the concentration are lower than the above range, this is undesirable because the layer thickness of the resulting metal pattern is too thin and it may be difficult to put it into practical use, though depending on use. On the other hand, when the viscosity and the concentration are higher than the above range, this is undesirable because there is the possibility that patterning cannot be accomplished when such metal colloid is applied to the entire surface.

[0202]

The surface tension of the metal colloid is preferably 20 mN/m or more, more preferably 50 mN/m or more, and particularly preferably 70 mN/m or more. When the surface tension is lower than the above range, this is undesirable because there is the possibility that the contact angle of the liquid repellent area cannot be made to be large with the result that there is the possibility of the metal colloid being left also in the liquid repellent area. Although there is no particular limitation to the upper limit of the surface tension of the metal colloid, the upper limit is preferably 80 mN/m or less.

[0203]

As aforementioned, the metal colloid used in the present invention is preferably a solution having high surface tension. This reason is that when coated to the entire surface as aforementioned, the metal colloid coated to the liquid repellent area, other than the lyophilic area, must be removed, or concentrated in the lyophilic area. And for this, the contact angle of the liquid repellent area with the metal colloid is preferably large. In the present invention, a metal colloid using water as a medium is preferably used from this point of view.

[0204]

The type of metal used for the metal colloid in the present invention is preferably silver or gold. This is because these have good conductivity and corrosion resistance.

[0205]

Therefore, in the present invention, a gold colloid or silver colloid using water as a medium is preferably used.

[0206]

(5) Conductive pattern forming process

In the present invention, finally a conductive pattern forming process is carried out wherein the metal colloid adhered in a pattern is solidified to form a conductive pattern. Thus, the pattern forming body substrate is finally formed into the conductive pattern forming body.

[0207]

As the solidifying method used here, heating is most general. The metal colloid is heated at temperatures in a range of 100°C to 700°C, and preferably 250°C to 500°C. Heating time is in a range of 10 minutes to 60 minutes and preferably 20 minutes to 40 minutes.

[0208]

(6) Non-drawn part removing process

The method for manufacturing a conductive pattern forming body in the present invention may comprise, besides the above processes, a non-drawn part removing process wherein the property variable layer is removed, except for the part where the conductive pattern has been formed in the aforementioned conductive pattern forming process. When the property variable layer is conductive, it is difficult to form a conductive pattern forming body even if a conductive pattern is provided on the pattern forming body. Therefore, the base body is bared by removing the property variable layer, in an area except for the conductive pattern, to form a conductive pattern forming body. In this case, the base body must be an insulated material among the aforementioned materials.

[0209]

The non-drawn part removing process in the present invention is a process of removing non-drawn part 7 (FIG. 6b) comprising the photocatalyst containing layer bared on the surface of an area other than the conductive pattern 11 area of the pattern forming body substrate (FIG. 6a) formed in the above conductive pattern forming process. The method is not particularly limited as long as the method can remove the non-drawn part 7.

[0210]

Specific methods for removing this non-drawn part include a method in which an alkali solution or a strong acid such as hydrofluoric acid or concentrated sulfuric acid is coated by a spray or dipped.

[0211]

(7) Others

In the present invention, the conductive pattern forming body may be subjected to electroplating to increase the layer thickness of the conductive pattern. This is because, by doing so, the resistance of the conductive pattern can be reduced and at the same time, the strength of adhesion of the conductive pattern to the property variable layer can be improved, leading to the formation of a high quality and highly precise wiring board.

[0212]

Also, in the present invention, an insulating protective layer may be further formed after the above conductive pattern is formed. This is because by doing so, such disorders that the conductive pattern is peeled off can be prevented. Also, when this insulating protective layer is a property variable

layer, it can be used as a multilayer print board by further forming a conductive pattern thereon.

[0213]

B. Pattern forming body

Next, the pattern forming body of the present invention will be explained. The pattern forming body of the present invention has three embodiments. Each pattern forming body will be explained hereinbelow.

[0214]

1. First embodiment

Next, the first embodiment of the pattern forming body of the present invention will be explained. The first embodiment of the pattern forming body of the present invention comprises: a wettability variable layer whose wettability is changed by an action of a photocatalyst; and a metal composition formed on the wettability variable layer by solidifying a metal colloid in a pattern. The pattern forming body in the present invention is provided with the wettability variable layer, therefore, a lyophilic area and a liquid repellent area can be formed in a pattern with ease by energy irradiation. And it is therefore possible to form a conductive pattern forming body easily by adhering the metal colloid to this lyophilic area.

[0215]

Moreover, in the present embodiment, the electric resistance of the wettability variable layer is preferably in a range of $1 \times 10^8 \Omega \cdot \text{cm}$ to $1 \times 10^{18} \Omega \cdot \text{cm}$, and particularly preferably in a range of $1 \times 10^{12} \Omega \cdot \text{cm}$ to $1 \times 10^{18} \Omega \cdot \text{cm}$, since the conductive pattern is formed on the wettability variable layer. It is thereby possible to form an excellent conductive

pattern forming body.

[0216]

The structure and the like of the pattern forming body in the present embodiment is not particularly limited as long as the pattern forming body is provided with the wettability variable layer and the metal composition formed in a pattern on the wettability variable layer. As shown in FIG. 7a for example, a wettability variable layer 5, which is one of property variable layers, may be formed on a base body 4, and a metal composition 11 may be formed in a pattern on the wettability variable layer 5. Or as shown in FIG. 7b for example, a metal composition 11 may be formed in a pattern on the wettability variable layer 5, when the wettability variable layer 5 has a self-supporting ability.

[0217]

As the wettability variable layer and base material used in the present embodiment, those explained in the aforementioned paragraph "Pattern forming body substrate preparing process" in the section of "A. Method for manufacturing a conductive pattern forming body" may be used, therefore, explanations are omitted here. Also, as the metal composition used in the present invention is obtained by solidifying a metal colloid in a pattern. The material and the method for manufacturing are the same as those explained in the aforementioned paragraph "Metal colloid coating process" and "Conductive pattern forming process" in the section of "A. Method for manufacturing a conductive pattern forming body", therefore, explanations are omitted here.

[0218]

2. Second embodiment

Next, the second embodiment of the conductive pattern forming body will be explained. The second embodiment of the conductive pattern forming body of the present invention comprises: a base body; a decomposition removal layer on the base body which is decomposed and removed by an action of a photocatalyst; and a metal composition formed on the base body which is bared by the decomposition and removal of the decomposition removal layer, by solidifying a metal colloid in a pattern.

[0219]

The structure and the like of the conductive pattern forming body of the present embodiment is not particularly limited, and comprises, as shown in FIG. 8 for example, a base body 4, a decomposition removal layer 5, which is a property variable layer, formed on the base body 4, and a metal composition 11 formed on the base body 4 which is bared as a result of decomposition and removal of this decomposition removal layer 5.

[0220]

The conductive pattern forming body of the present embodiment is provided with the decomposition removal layer. It is therefore possible to form irregularities in a pattern on the surface with ease by irradiating with energy and to manufacture a conductive pattern forming body by utilizing this irregularities. In the decomposition removal layer of the present invention, a contact angle of the decomposition removal layer to a metal colloid is preferably different from a contact angle of the base body to the metal collid. This reason is that a conductive pattern forming body can be manufactured by

utilizing not only the irregularities on the surface, but also a difference in wettability.

[0221]

Also, in this case, the electric resistance of the base body is preferably in a range of $1 \times 10^8 \Omega \cdot \text{cm}$ to $1 \times 10^{18} \Omega \cdot \text{cm}$, and particularly preferably in a range of $1 \times 10^{12} \Omega \cdot \text{cm}$ to $1 \times 10^{18} \Omega \cdot \text{cm}$, since the conductive pattern is formed on the base body.

[0222]

Further, the electric resistance of this decomposition removal layer is preferably in a range of $1 \times 10^8 \Omega \cdot \text{cm}$ to $1 \times 10^{18} \Omega \cdot \text{cm}$, and particularly preferably in a range of $1 \times 10^{12} \Omega \cdot \text{cm}$ to $1 \times 10^{18} \Omega \cdot \text{cm}$, since the decomposition removal layer is existing around the conductive pattern. It is thereby possible to form an excellent conductive pattern forming body.

[0223]

As the decomposition removal layer and base body used in the present embodiment, those explained in the aforementioned paragraph "Pattern forming body substrate preparing process" in the section of "A. Method for manufacturing a conductive pattern forming body" may be used, therefore, explanations are omitted here. Also, the metal composition used in the present invention is obtained by solidifying the metal colloid in a pattern. The material and the method for manufacturing are the same as those explained in the aforementioned paragraph "Metal colloid coating process" and "Conductive pattern forming process" in the section of "A. Method for manufacturing a conductive pattern forming body", therefore, explanations are omitted here.

[0224]

3. Third embodiment

Next, a third embodiment of the conductive pattern forming body of the present invention will be explained. The third embodiment of the conductive pattern forming body of the present invention comprises: a base body; a wettability variable layer formed in a pattern on the base body whose wettability is changed by an action of a photocatalyst; and a metal composition formed on the wettability variable layer, by solidifying a metal colloid.

[0225]

The structure and the like of the conductive pattern forming body of the present embodiment is not particularly limited, and comprises, as shown in FIG. 9 for example, a base body 4, a wettability variable layer 5, which is a property variable layer, formed in a pattern on the base body 4, and a metal composition 11 formed on the wettability variable layer 5.

[0226]

The conductive pattern forming body of the present embodiment is provided with the wettability variable layer. And it is therefore possible to manufacture the conductive pattern forming body with ease by utilizing the difference in wettability. Also, since the wettability variable layer is formed in a pattern on the base body and the conductive pattern is formed on the wettability variable layer, the base body is bared on the surface of a part other than the conductive pattern. This makes it possible to form a conductive pattern forming body even when the wettability variable layer is conductive. In this

case, the electric resistance of the base body is preferably in a range of $1 \times 10^8 \Omega\text{-cm}$ to $1 \times 10^{18} \Omega\text{-cm}$, and particularly preferably in a range of $1 \times 10^{12} \Omega\text{-cm}$ to $1 \times 10^{18} \Omega\text{-cm}$. It is thereby possible to form an excellent conductive pattern forming body.

[0227]

As the decomposition removal layer and base body used in the present invention, those explained in the aforementioned paragraph "Pattern forming body substrate preparing process" in the section of "A. Method for manufacturing a conductive pattern forming body" may be used, therefore, explanations are omitted here. Also, the metal composition used in the present embodiment is obtained by solidifying the metal colloid in a pattern. The material and the method for manufacturing are the same as those explained in the aforementioned paragraph "Metal colloid coating process" and "Conductive pattern forming process" in the section of "A. Method for manufacturing a conductive pattern forming body", therefore, explanations are omitted here.

[0228]

The present invention is not limited to the aforementioned embodiments. These embodiments are examples and whatever has substantially the same structure and produces the same action effect as the technical spirit described in the claim of the present invention is embraced by the technical scope of the present invention.

[0229]

EXAMPLES

The present invention will be explained in more detail

by way of examples.

[0230]

[Example 1]

A titanium oxide coating agent TKC 301 for photocatalyst manufactured by TAYCA CORPORATION was coated on a quartz glass substrate, on which a 0.4 μm thickness chromium black matrix with 50 μm line and space was formed, and dried at 350°C for 3 hours to prepare a photocatalyst containing layer side substrate.

[0231]

Next, 3 g of aqueous 0.1N hydrochloric acid was added to 0.4 g of MF-160E (trade name, manufactured by Tochem Products Co., Ltd.) containing fluoroalkylsilane as its major component, and was stirred at ambient temperature for 1 hour to prepare a solution. The solution was coated on a glass substrate and dried at 150°C for 10 minutes to prepare a pattern forming body substrate.

[0232]

The photocatalyst containing layer side substrate was brought into close contact with the pattern forming body substrate, and was exposed to light (365 nm, 1000 mJ/cm²) of an ultra high pressure mercury lamp from the photocatalyst containing layer side substrate to form a lyophilic area on the surface of the pattern forming body substrate.

[0233]

The contact angle of the liquid repellent area to a silver colloid using water as a medium (concentration: 20 wt%) was 75°, and the contact angle of the lyophilic area was 10°.

[0234]

The above pattern forming body substrate was dipped in a silver colloid using water as a medium (concentration: 20 wt%), and then pulled up at a rate of 10 mm/sec, whereby the silver colloid was adhered in a pattern only to the lyophilic area. This silver colloid pattern was heated at 300°C for 20 minutes to obtain a conductive pattern forming body in which silver is patterned on the substrate.

[0235]

[Example 2]

A titanium oxide coating agent TKC 301 for photocatalyst manufactured by TAYCA CORPORATION was coated on a quartz glass substrate, on which a 0.4 μm thickness chromium black matrix with 50 μm line and space was formed, and dried at 350°C for 3 hours to prepare a photocatalyst containing layer side substrate.

[0236]

Next, 3 g of aqueous 0.1N hydrochloric acid was added to 0.4 g of MF-160E (trade name, manufactured by Tochem Products Co., Ltd.) containing fluoroalkylsilane as its major component, and was stirred at ambient temperature for 1 hour to prepare a solution. The solution was coated on a glass substrate and dried at 150°C for 10 minutes to prepare a pattern forming body substrate.

[0237]

The photocatalyst containing layer side substrate was brought into close contact with the pattern forming body substrate, and was exposed to light (365 nm, 600 mJ/cm²) of a ultra high pressure mercury lamp from the photocatalyst containing layer side substrate to form a lyophilic area on the

surface of the pattern forming body substrate.

[0238]

The contact angle of the liquid repellent area to a silver colloid using water as a medium (concentration: 20 wt%) was 75°, and the contact angle of the lyophilic area was 30°.

[0239]

The above pattern forming body substrate was dipped in a silver colloid using water as a medium (concentration: 20 wt%), and then pulled up at a rate of 10 mm/sec, whereby the silver colloid was adhered in a pattern only to the lyophilic area. This silver colloid pattern was heated at 300°C for 20 minutes to obtain a conductive pattern forming body in which silver is patterned on the substrate.

[0240]

[Example 3]

A photocatalyst containing layer side substrate and a pattern forming body substrate were prepared in the same manner as in Example 1 and were exposed in a pattern to light in the same manner to form a lyophilic area on the surface of the pattern forming body substrate.

[0241]

The contact angle of the unexposed part, that is, the liquid repellent area to a silver colloid using water as a medium (concentration: 50 wt%) was 83°, and the contact angle of the exposed part, that is, the lyophilic area was 12°.

[0242]

The above substrate was dipped in the silver colloid using water as a medium (concentration: 50 wt%), and then pulled up at a rate of 10 mm/sec, whereby the silver colloid was adhered

in a pattern only on the lyophilic area. This silver colloid pattern was heated at 300°C for 20 minutes to obtain a conductive pattern forming body in which silver is patterned on the substrate.

[0243]

[Comparative Example 1]

A titanium oxide coating agent TKC 301 for photocatalyst manufactured by TAYCA CORPORATION was coated on a quartz glass substrate, on which a 0.4 μm thickness chromium black matrix with 50 μm line and space was formed, and dried at 350°C for 3 hours to prepare a photocatalyst containing layer side substrate.

[0244]

Next, 3 g of aqueous 0.1N hydrochloric acid was added to 0.4 g of MF-160E (trade name, manufactured by Tochem Products Co., Ltd.) containing fluoroalkylsilane as its major component, and was stirred at ambient temperature for 1 hour to prepare a solution. The solution was coated on a glass substrate and dried at 150°C for 10 minutes to prepare a pattern forming body substrate.

[0245]

The photocatalyst containing layer side substrate was brought into close contact with the pattern forming body substrate, and was exposed to light (365 nm, 300 mJ/cm^2) of a ultra high pressure mercury lamp from the photocatalyst containing layer side substrate to form a lyophilic area on the surface of the pattern forming body substrate.

[0246]

The contact angle of the liquid repellent area to a silver

colloid using water as a medium (concentration: 20 wt%) was 75°, and the contact angle of the lyophilic area was 45°.

[0247]

The above pattern forming body substrate was dipped in a silver colloid using water as a medium (concentration: 20 wt%), and then pulled up at a rate of 10 mm/sec. However, the silver colloid was repelled on the entire surface including the lyophilic area, and thus, a conductive pattern forming body could not be obtained.

[0248]

[Comparative Example 2]

A titanium oxide coating agent TKC 301 for photocatalyst manufactured by TAYCA CORPORATION was coated on a quartz glass substrate, on which a 0.4 μm thickness chromium black matrix with 50 μm line and space was formed, and dried at 350°C for 3 hours to prepare a photocatalyst containing layer side substrate.

[0249]

Next, 3 g of trimethoxymethylsilane (trade name: TSL8113, manufactured by Toshiba Silicones) and 3 g of aqueous 0.1N hydrochloric acid were added to 30 g of isopropyl alcohol and was stirred at 100°C for 20 minutes to prepare a solution. The solution was coated on a glass substrate and dried at 150°C for 10 minutes to prepare a pattern forming body substrate provided with a wettability variable layer containing no fluorine.

[0250]

The photocatalyst containing layer side substrate was brought into close contact with the pattern forming body substrate, and was exposed to light (365 nm, 600 mJ/cm²) of a

ultra high pressure mercury lamp from the photocatalyst containing layer side substrate to form a lyophilic area on the surface of the pattern forming body substrate.

[0251]

The contact angle of the liquid repellent area to a silver colloid using water as a medium (concentration: 20 wt%) was 44°, and the contact angle of the lyophilic area was 10°.

[0252]

The above pattern forming body substrate was dipped in a silver colloid using water as a medium (concentration: 20 wt%), and then pulled up at a rate of 10 mm/sec. However, the silver colloid was coated on the entire surface including the liquid repellent area, and thus, a conductive pattern forming body could not be obtained.

[0253]

[Example 4]

5 g of trimethoxymethylsilane (TSL 8113, manufactured by GE Toshiba Silicones Co., Ltd.) and 2.5 g of 0.5N hydrochloric acid were mixed and was stirred for 8 hours. This mixture was diluted with isopropyl alcohol by 10 times, thereby making a primer layer composition.

[0254]

The primer layer composition was coated on a photomask substrate by a spin coater and dried at 150°C for 10 minutes to form a transparent primer layer (thickness: 0.2 μ m). Next, 30 g of isopropyl alcohol, 3 g of trimethoxymethylsilane (TSL8113, manufactured by GE Toshiba Silicones Co., Ltd.), and 20 g of ST-K03 (manufactured by Ishihara Sangyo Kaisha, Ltd.) which is a photocatalyst inorganic coating agent, were mixed

and the mixture was stirred at 100°C for 20 minutes. The mixed solution was diluted with isopropyl alcohol by 3 times to make a photocatalyst containing layer composition. The photocatalyst containing layer composition was coated on the photomask substrate on which the primer layer was formed by a spin coater, and then dried at 150°C for 10 minutes to form a transparent photocatalyst containing layer (thickness: 0.15 μm).

[0255]

Next, 2 g of Iupilon Z400 (manufactured by Mitsubishi Gas Chemical Company, Inc.) containing a polycarbonate as its major component was dissolved into 30 g of dichloromethane and 70 g of 1,1,2-trichloroethane to prepare a decomposition removal layer composition. The decomposition removal layer composition was coated on a glass substrate by a spin coater and dried at 100°C for 60 minutes to form a transparent decomposition removal layer (thickness: 0.01 μm), thereby obtaining a pattern forming body substrate.

[0256]

The photocatalyst containing layer side substrate and the decomposition removal layer were aligned so that they are facing to each other with a 100 μm gap, and then exposed to light of a ultra high pressure mercury lamp (wavelength: 365 nm) from the photomask side at an intensity of 40 mW/cm² for 600 seconds to decompose and remove the decomposition removal layer, thereby forming a decomposition removal pattern comprising the bared glass base member in a pattern.

[0257]

At this time, each contact angle of the unexposed part

and the decomposition removal pattern to a silver colloid using water as a medium (concentration: 20%) was measured (30 seconds after liquid droplets were dripped from a micro-syringe) by using a contact angle measuring device (CA-Z model, manufactured by Kyowa Interface Science Co., LTD.). As a result, each contact angle was 65° and 6°.

[0258]

Next, the silver colloid using water as its medium (concentration: 20%) was adhered to the decomposition removal pattern by using an ink jet device, and then treated at 300°C for 60 minutes to cure, thereby forming a conductive pattern.

[0259]

Finally, the substrate on which the conductive pattern was formed was dipped in an aqueous alkali solution containing potassium hydroxide as its major component and having a pH of 13 for 2 minutes, and then rinsed with water for 5 minutes to remove the non-drawn part, thereby obtaining a conductive pattern forming body.

[0260]

[Example 5]

5 g of trimethoxymethylsilane (TSL 8113, manufactured by GE Toshiba Silicones Co., Ltd.) and 2.5 g of 0.5N hydrochloric acid were mixed and was stirred for 8 hours. This mixture was diluted with isopropyl alcohol by 10 times, thereby making a primer layer composition. The primer layer composition was coated on a photomask substrate by a spin coater and dried at 150°C for 10 minutes to form a transparent primer layer (thickness: 0.2 μm). Next, 30 g of isopropyl alcohol, 3 g of trimethoxymethylsilane (TSL8113, manufactured by GE Toshiba

Silicones Co., Ltd.), and 20 g of ST-K03 (manufactured by Ishihara Sangyo Kaisha, Ltd.) which is a photocatalyst inorganic coating agent, were mixed and the mixture was stirred at 100°C for 20 minutes. The mixed solution was diluted with isopropyl alcohol by 3 times to make a photocatalyst containing layer composition.

[0261]

The photocatalyst containing layer composition was coated on the photomask substrate on which the primer layer was formed by a spin coater, and then dried at 150°C for 10 minutes to form a transparent photocatalyst containing layer (thickness: 0.15 μm).

[0262]

Next, a polydiallyldimethylammonium chloride (PDDA, average molecular weight: 100,000 to 200,000, Aldorich) which is a cationic polymer and a sodium polystyrenesulfonate (PSS, average molecular weight: 70,000, Aldorich) which is an anionic polymer were self-assembled layer by layer on a glass base member in a thickness of about 2 nm to form a pattern forming substrate.

[0263]

The photocatalyst containing layer side substrate and the decomposition removal layer were aligned so that they are facing to each other with a 50 μm gap, and then exposed to light of a ultra high pressure mercury lamp (wavelength: 365 nm) from the photomask side at an intensity of 40 mW/cm² for 120 seconds to decompose and remove the decomposition removal layer, thereby forming a decomposition removal pattern comprising the bared glass base member in a pattern.

[0264]

At this time, each contact angle of the unexposed part and the decomposition removal pattern to a silver colloid using water as a medium (concentration: 20%) was measured (30 seconds after liquid droplets were dripped from a micro-syringe) by using a contact angle measuring device (CA-Z model, manufactured by Kyowa Interface Science Co., LTD.). As a result, each contact angle was 62° and 6°.

[0265]

Next, the silver colloid using water as its medium (concentration: 20%) was adhered to the decomposition removal pattern by using an ink jet device, and then treated at 300°C for 60 minutes to cure, thereby obtaining a conductive pattern forming body.

[0266]

[Effect of the Invention]

According to the present invention, the metal colloid can be formed in a pattern on the wettability variable layer whose property is changed by carrying out treatment of adhering the metal colloid thereto by using, for example, a dip coating method or an ink jet method, and can be made into a highly precise conductive pattern by solidifying it. As a consequence, since a highly precise conductive pattern can be formed in a simple process with high accuracy, a highly precise conductive pattern can be formed at a low cost. Further, when the property variable layer is made of, for example, an insulated material, a highly precise conductive pattern can be formed.

[Brief Description of the Drawing]

[FIG. 1]

A process diagrams showing one example of a method for

manufacturing a conductive pattern forming body according to the present invention

[FIG. 2]

A schematic sectional view showing one example of a photocatalyst containing layer side substrate used in the present invention.

[FIG. 3]

A schematic sectional view showing another example of a photocatalyst containing layer side substrate used in the present invention.

[FIG. 4]

A schematic sectional view showing another example of a photocatalyst containing layer side substrate used in the present invention.

[FIG. 5]

A schematic sectional view showing another example of a photocatalyst containing layer side substrate used in the present invention.

[FIG. 6]

A process diagrams showing one example of a non-drawn part removing process of a method for manufacturing a conductive pattern forming body according to the present invention.

[FIG. 7]

A schematic sectional view showing one example of a conductive pattern forming body according to the present invention.

[FIG. 8]

A schematic sectional view showing another example of a conductive pattern forming body according to the present

invention.

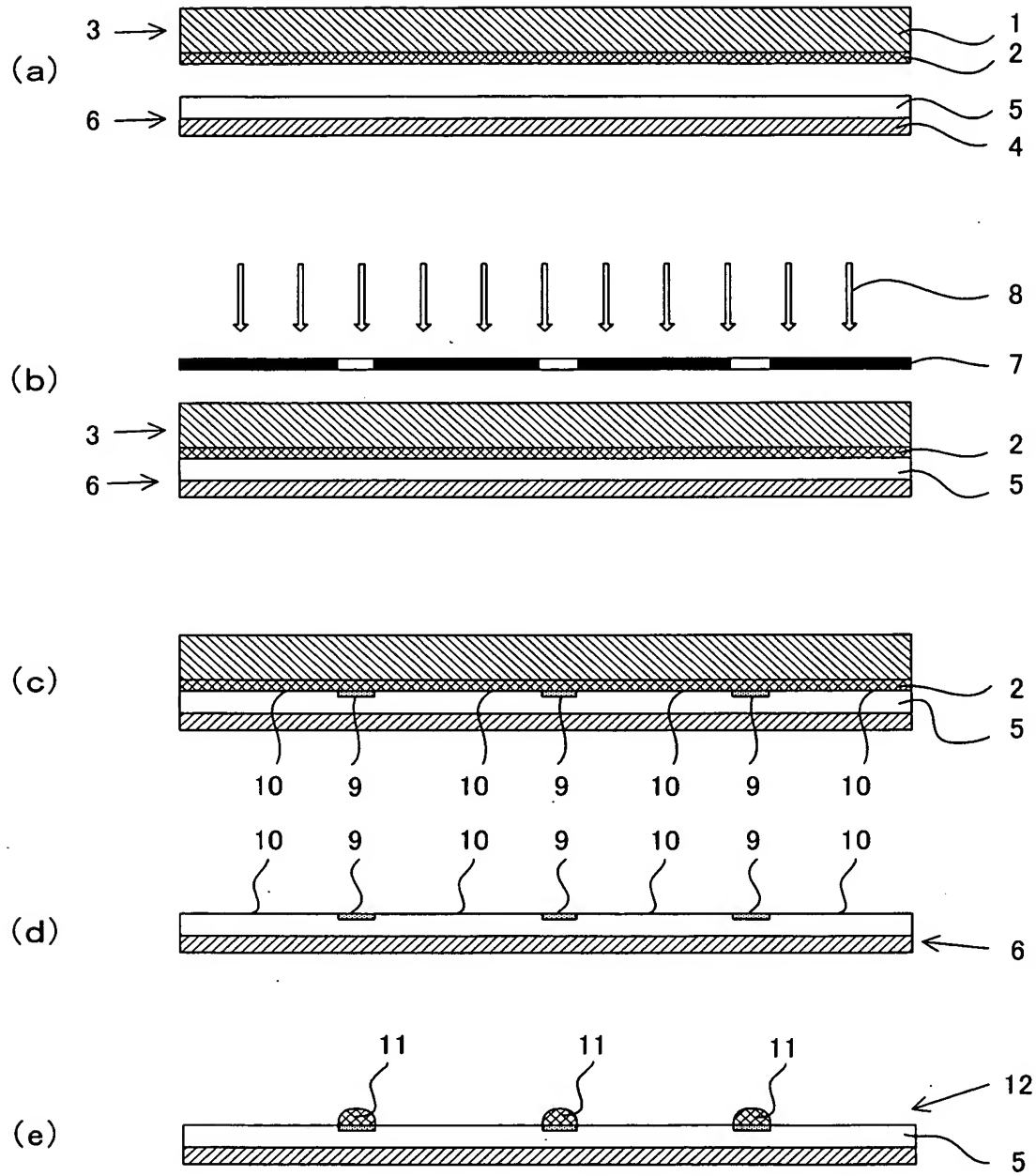
[FIG. 9]

A schematic sectional view showing another example of a conductive pattern forming body according to the present invention.

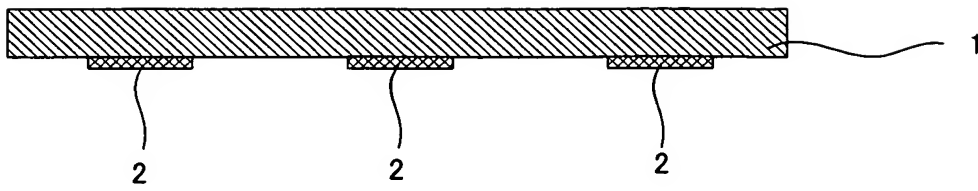
[Description of the reference number]

- 1 Base material
- 2 Photocatalyst containing layer
- 3 Photocatalyst containing layer side substrate
- 4 Base body
- 5 Property variable layer
- 6 Pattern forming body substrate
- 7 Non-drawn part
- 9 Property changed region
- 10 Property unchanged region
- 12 Conductive pattern forming body
- 12 Photocatalyst containing layer side light shielding part
- 12 Primer layer

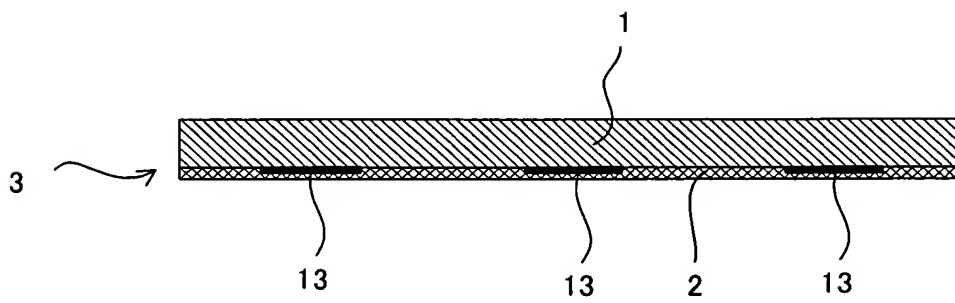
[FIG. 1]



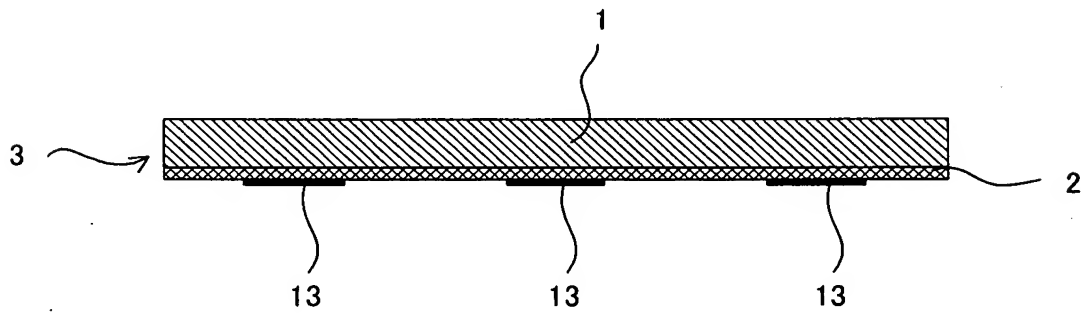
[FIG. 2]



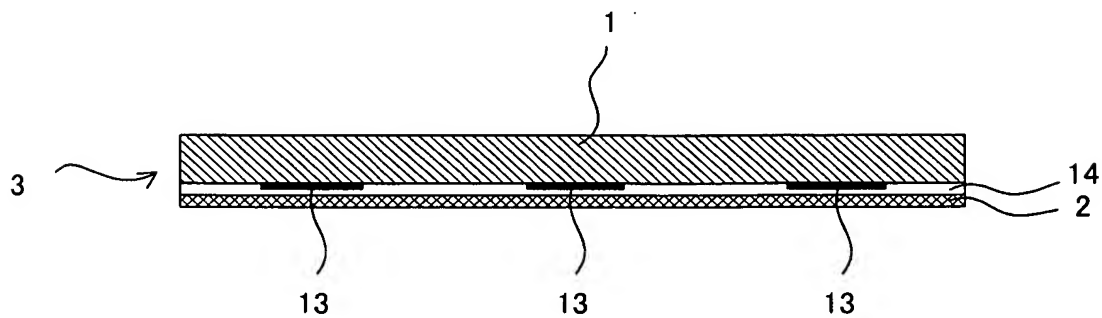
[FIG. 3]



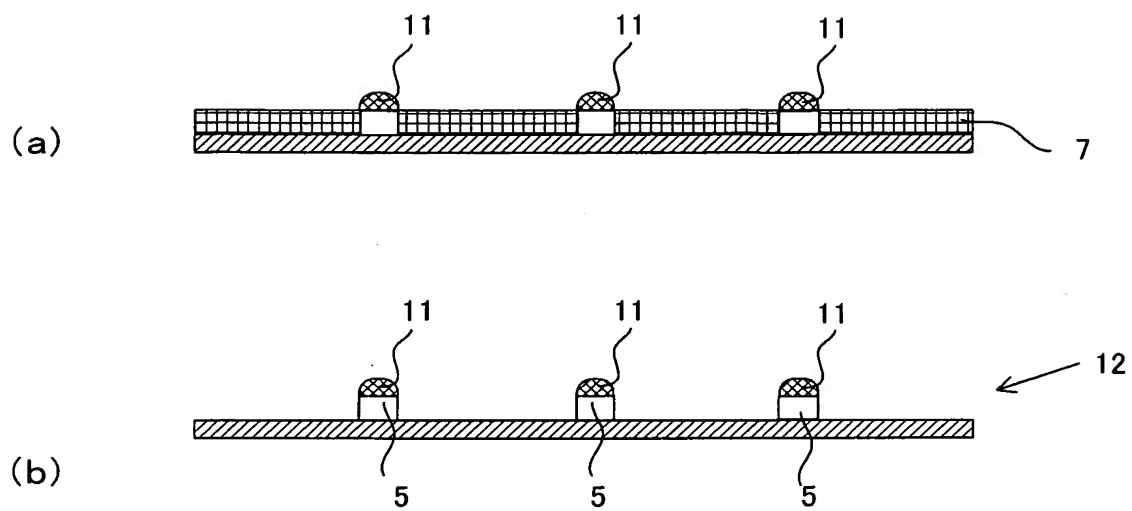
[FIG. 4]



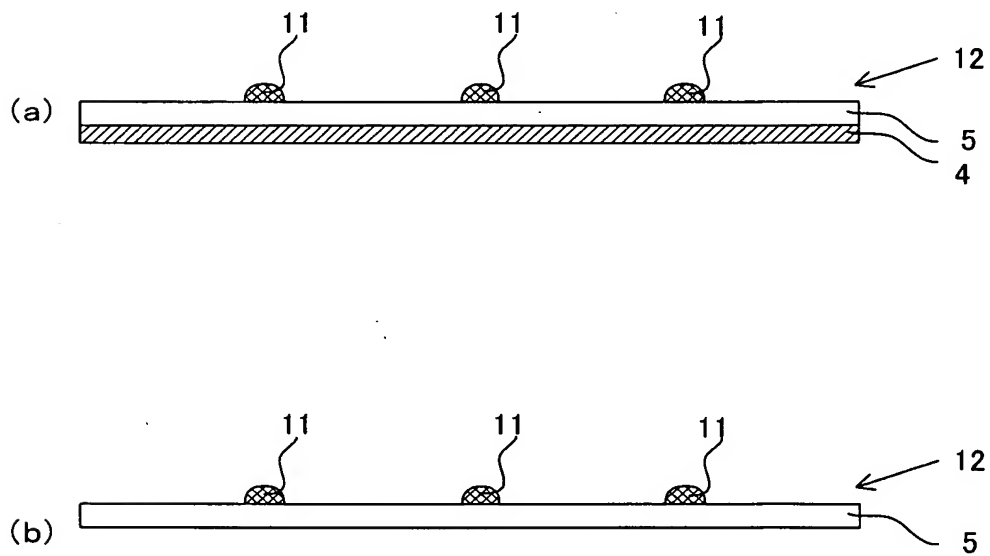
[FIG. 5]



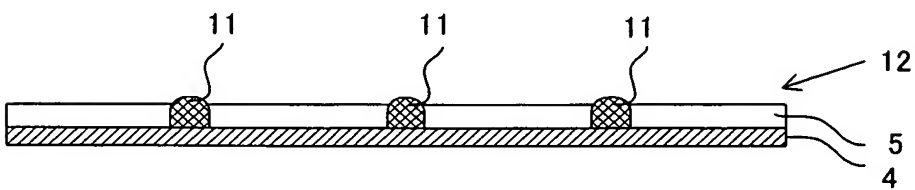
[FIG. 6]



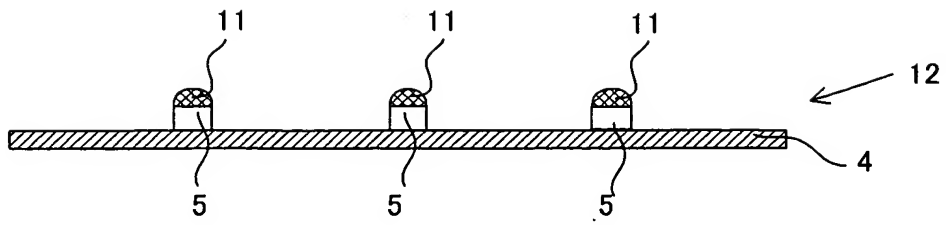
[FIG. 7]



[FIG. 8]



[FIG. 9]



[Document Title]

ABSTRACT

[Abstract]

[Object] It is a main object of the present invention to provide a method for manufacturing a conductive pattern capable of forming a highly precise pattern, also capable of forming by using a simple process, and being free from problems such as treatment of waste fluids.

[Means of solution] To attain the object, the present invention provides a method for manufacturing a conductive pattern forming body comprising: a photocatalyst containing layer side substrate preparing process of preparing a photocatalyst containing layer side substrate comprising a photocatalyst containing layer which contains a photocatalyst and a base material; a pattern forming body preparing process of preparing a pattern forming body substrate comprising a property variable layer whose property is changed by an action of a photocatalyst in the photocatalyst containing layer; a property variable pattern forming process of placing a photocatalyst containing layer and the property variable layer in contact, and then, irradiating with energy from predetermined direction to form a property variable pattern, whose property is changed, on a surface of the property variable layer; a metal colloid coating process of adhering a metal colloid in a pattern to the surface of the pattern forming body substrate on which the property variable pattern is formed by coating the metal colloid; and a conductive pattern forming process of forming conductive pattern by solidifying the metal colloid adhered in a pattern to the property variable pattern.

[Elected Drawing] FIG. 1